

Adept Viper s650/s850 Robot with MB-60R/eMB-60R User's Guide



adept®

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Chapter 1: Introduction

1.1 Product Description

Adept Viper s650/s850 Robots

The Adept Viper s650™ robot and Adept Viper s850™ robots are high-performance, six-axis robots designed specifically for assembly applications. The speed and precision of the Adept Viper robots also make them ideal for material handling, packaging, machine tending, and many other operations requiring fast and precise automation.

NOTE: The descriptions and instructions in this manual apply to both the Adept Viper s650 and the Adept Viper s850 robots, except for instances where there is a difference, as in dimension and work envelope drawings. In those cases, the information is presented for both robots. Either robot's motors can be powered by either an MB-60R or eMB-60R servo-controller/amplifier. Either robot can be controlled by either an Adept SmartController CX or Adept SmartController EX motion controller.

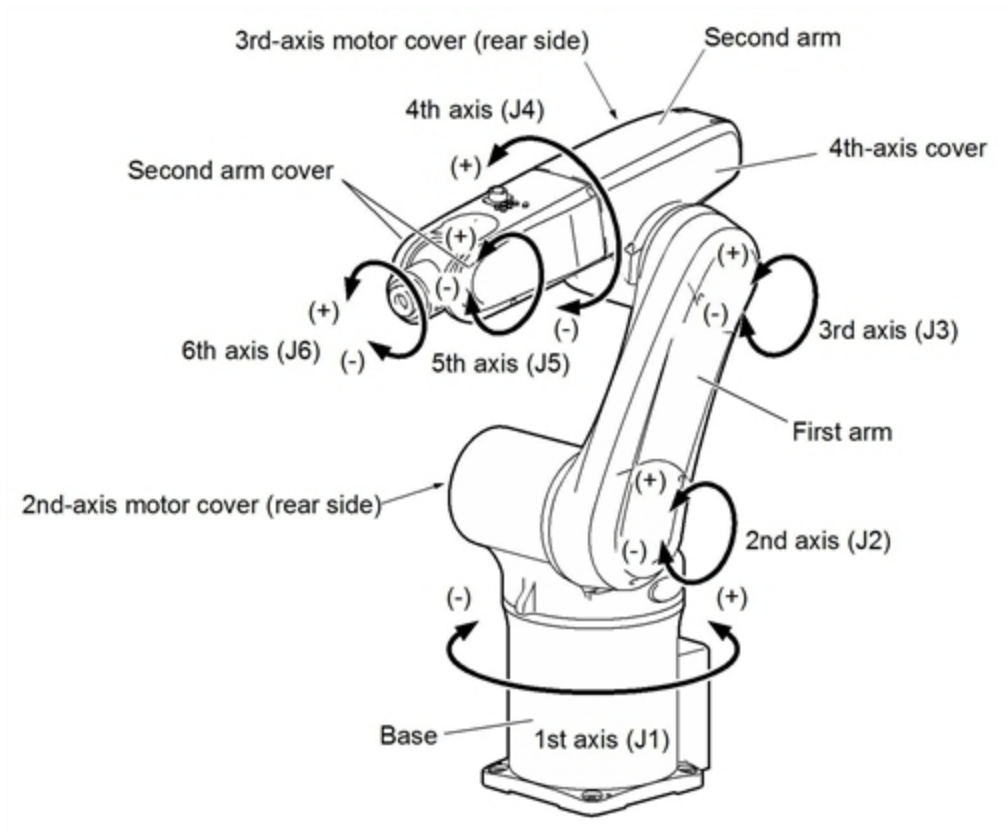


Figure 1-1. Robot Axis Identification

Adept SmartController

The SmartController™ motion controller is the foundation of Adept's family of high-performance distributed motion and vision controllers. The SmartController is designed for use with:

- Adept Cobra™ s-Series robots
- Adept Quattro™ robots
- Adept Viper™ s-Series robots
- Adept Python™ linear modules
- Adept MotionBlox-10™
- Adept sMI6™ (SmartMotion)

The SmartController supports a conveyor tracking option, as well as other options. There are two models available: the SmartController CX, which uses the V+ Operating System, and the SmartController EX, which uses the eV+ Operating System. Both models offer scalability and support for IEEE 1394-based digital I/O and general motion expansion modules. The IEEE 1394 interface is the backbone of Adept SmartServo, Adept's distributed controls architecture supporting Adept products. The SmartController also includes Fast Ethernet and DeviceNet.

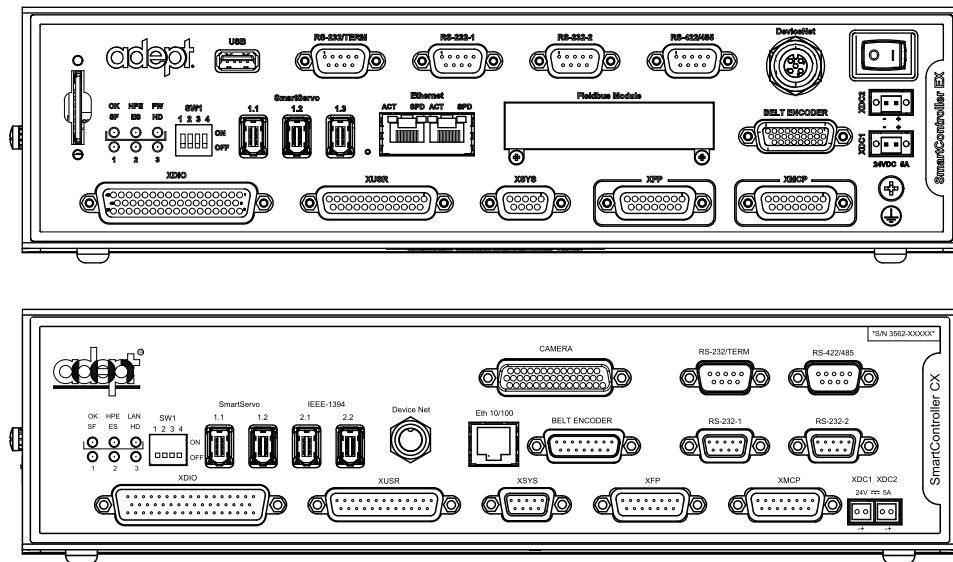


Figure 1-2. Adept SmartController EX and CX Motion Controllers

Adept MotionBlox-60R

The Adept MotionBlox-60R™ (MB-60R™/eMB-60R™) distributed servo controller contains the amplifiers to power the high-power motors of the Adept Viper s650/s850 robots.

The Adept MB-60R/eMB-60R feature:

- Six AC servo motor amplifiers
- Emergency stop circuitry
- High servo rate, to deliver low positional errors and superior path following
- Sine wave commutation, for low cogging torque and improved path following
- Digital feed-forward design, to maximizes efficiency, torque, and velocity
- Integral temperature sensors and status monitoring for maximum reliability
- Dual-digit diagnostics display for easy troubleshooting

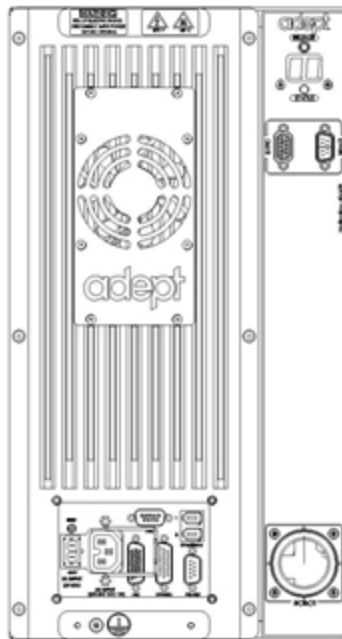


Figure 1-3. MotionBlox-60R (MB-60R shown)

1.2 Dangers, Warnings, Cautions, and Notes

There are six levels of special alert notation used in Adept manuals. In descending order of importance, they are:



DANGER: This indicates an imminently hazardous electrical situation which, if not avoided, will result in death or serious injury.



DANGER: This indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.



WARNING: This indicates a potentially hazardous electrical situation which, if not avoided, could result in injury or major damage to the equipment.



WARNING: This indicates a potentially hazardous situation which, if not avoided, could result in injury or major damage to the equipment.



CAUTION: This indicates a situation which, if not avoided, could result in damage to the equipment.

NOTE: Notes provide supplementary information, emphasize a point or procedure, or give a tip for easier operation.

1.3 Intended Use of the Robots

The Adept Viper robots are intended for use in parts assembly and material handling for payloads less than 5 kg. See Technical Specifications on page 83 for complete information on the robot specifications. Refer to the [Adept Robot Safety Guide](#) for details on the intended use of Adept robots.

1.4 Safety Precautions



DANGER: An Adept Viper s650/s850 robot can cause serious injury or death, or damage to itself and other equipment, if the following safety precautions are not observed:

- All personnel who install, operate, teach, program, or maintain the system must read this guide, read the [Adept Robot Safety Guide](#), and complete a training course for their responsibilities in regard to the robot.
- All personnel who design the robot system must read this guide, read the [Adept Robot Safety Guide](#), and must comply with all local and national safety regulations for the

location in which the robot is installed.

- The robot system must not be used for purposes other than described in Intended Use of the Robots on page 12. Contact Adept if you are not sure of the suitability for your application.
- The user is responsible for providing safety barriers around the robot to prevent anyone from accidentally coming into contact with the robot when it is in motion.
- Power to the robot and its amplifiers must be locked out and tagged out before any maintenance is performed.

1.5 What to Do in an Emergency Situation

Press any E-Stop button (a red push-button on a yellow background/field) and then follow the internal procedures of your company or organization for an emergency situation. If a fire occurs, use CO₂ to extinguish the fire.

1.6 Additional Safety Information

Adept provides other sources for more safety information:

Manufacturer's Declaration of Compliance (MDOC)

This lists all standards with which each robot complies. Manufacturer's Declaration on page 14

Adept Robot Safety Guide

The [Adept Robot Safety Guide](#) provides detailed information on safety for Adept robots. It also gives resources for more information on relevant standards.

It ships with each robot manual, and is also available from the Adept Document Library. See Adept Document Library on page 15

1.7 Installation Overview

The system installation process is summarized in the following table. Refer also to the system cable diagram in System Installation on page 49.

For dual-robot installations, see the [Adept Dual-Robot Configuration Procedure](#), which is available in the Adept Document Library.

Table 1-1. Installation Overview

Task to be Performed	Reference Location
Mount the robot on a flat, secure mounting surface.	Mounting the Robot on page 22.
Install the SmartController, Front Panel, and Adept ACE software.	Robot Installation on page 17.
Install the IEEE 1394 and XSYS cables between the MB-60R/eMB-60R and SmartController.	Connecting Cables from the MB-60R/eMB-60R to the SmartController on page 52.
Install the Arm Power/Signal cable between the MB-60R/eMB-60R and the robot.	Installing the Arm Power/Signal Cable on page 52.
Create a 24 VDC cable and connect it between the MB-60R/eMB-60R and the user-supplied 24 VDC power supply.	Procedure for Creating 24 VDC Cable on page 54.
Create a 24 VDC cable and connect it between the SmartController and the user-supplied 24 VDC power supply.	Installing the SmartController on page 50.
Create a 200 - 240 VAC cable and connect it between the MB-60R/eMB-60R and the facility AC power source.	Connecting 200-240 VAC Power to MB-60R/eMB-60R on page 55.
Install user-supplied safety barriers in the workcell.	Installing User-Supplied Safety Equipment on page 61
Learn about connecting digital I/O through the XIO connector on the MB-60R/eMB-60R.	Connecting Digital I/O to the System on page 38
Read Chapter 5 to learn about system start-up and testing operation.	System Operation on page 63

1.8 Manufacturer's Declaration

The Manufacturer's Declaration of Incorporation and Conformity for Adept robot systems can be found on the Adept website, in the Download Center of the Support section.

<http://www.adept.com/support/downloads/file-search>

NOTE: The Download Center requires that you are logged in for access. If you are not logged in, you will be redirected to the Adept website Login page, and then automatically returned to the Download Center when you have completed the login process.

1. From the Download Types drop-down list, select Manufacturer Declarations.
2. From the Product drop-down list, select your Adept robot product category (such as Adept Cobra Robots, Adept Viper robots, etc.).

3. Click Begin Search.
4. The list of available documents is shown in the Search Results area, which opens at the bottom of the page. You may need to scroll down to see it.
5. Use the Description column to locate the document for your Adept robot, and then click the corresponding Download ID number to access the Download Details page.
6. On the Download Details page, click Download to open or save the file.

1.9 How Can I Get Help?

Refer to the [How to Get Help Resource Guide](#) (Adept P/N 00961-00700) for details on getting assistance with your Adept software and hardware. Additionally, you can access information sources on Adept's corporate Web site:

<http://www.adept.com>

Related Manuals

This manual covers the installation, operation, and maintenance of an Adept Viper s650/s850 robot system. There are additional manuals that cover programming the system, reconfiguring installed components, and adding other optional components. See the following table. These manuals are available on the Adept Document Library, and the software CD-ROM shipped with each system.

Table 1-2. Related Manuals

Manual Title	Description
Adept Robot Safety Guide	Contains general safety information for all Adept robots.
Adept SmartController User's Guide	Contains complete information on the installation and operation of the Adept SmartController and the optional sDIO product.
Adept T20 Pendant User's Guide	Describes the Adept T20™ pendant.
Adept T2 Pendant User's Guide	Describes the Adept T2™ pendant.
Adept IO Blox User's Guide	Describes the IO Blox product.
Adept ACE User's Guide	Describes the installation and use of Adept ACE.
Adept Dual Robot Configuration Procedure	Contains cable diagrams and configuration procedures for a dual-robot system.

Adept Document Library

The Adept Document Library (ADL) contains documentation for Adept products. You can access a local copy of the ADL from the Adept Software CD shipped with your system. Additionally, an Internet version of the ADL can be accessed by going to the Adept Web site and

Chapter 1: Introduction

selecting Document Library from the Support tab. To go directly to the Adept Document Library, type the following URL into your browser:

http://www.adept.com/Main/KE/DATA/adept_search.htm

To locate information on a specific topic, use the Document Library search engine on the ADL main page. To view a list of available product documentation, use the menu links located above the search field.

Chapter 2: Robot Installation

2.1 Unpacking and Inspecting the Adept Equipment

Before Unpacking

Carefully inspect all shipping crates for evidence of damage during transit. If any damage is apparent, request that the carrier's agent be present at the time the container is unpacked.

Upon Unpacking

Before signing the carrier's delivery sheet, please compare the actual items received (not just the packing slip) with your equipment purchase order and verify that all items are present and that the shipment is correct and free of visible damage.

If the items received do not match the packing slip, or are damaged, do **not** sign the receipt. Contact Adept as soon as possible.

If the items received do not match your order, please contact Adept immediately.

Inspect each item for external damage as it is removed from its container. If any damage is evident, contact Adept. See How Can I Get Help? on page 15.

Retain all containers and packaging materials. These items may be necessary to settle claims or, at a later date, to relocate equipment.

2.2 Repacking for Relocation

If the robot or other equipment needs to be relocated, reverse the steps in the installation procedures that follow in this chapter. Reuse all original packing containers and materials and follow all safety notes used for installation. Improper packaging for shipment will void your warranty. Specify this to the carrier if the robot is to be shipped.



CAUTION: Before transportation, set the robot in a transport position by manually moving the second, third, and fourth axes. See the following figure.

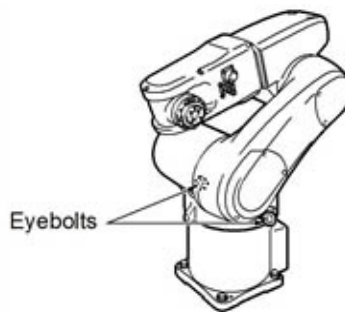


Figure 2-1. Robot in Transport Position

2.3 Environmental and Facility Requirements

The Adept robot system installation must meet the operating environment requirements shown in the following table.

Table 2-1. Robot System Operating Environment Requirements

Item	Condition
Flatness of the mounting surface	0.1/500 mm
Installation type	Floor-mount or Overhead-mount
Ambient temperature	During operation: 0 to 40° C During storage and transportation: -10 to 60° C
Humidity	During operation: 90% or less (Non-condensing) During storage and transportation: 75% or less (Non-condensing)
Vibration	During operation: 4.9 m/s ² (0.5 G) or less During storage and transportation: 29.4 m/s ² (3 G) or less
Safe Installation Environment	The robot should not be installed in an environment where: • There are flammable gases or liquids • There are any acidic, alkaline, or other corrosive gases • There is sulfuric or other types of cutting or grinding oil mist • There are any large-sized inverters, high output/high frequency transmitters, large contactors, welders, or other sources of electrical noise • There are any shavings from metal processing or other conductive material flying about • It may be directly exposed to water, oil, or cutting chips
Working space, etc.	• Sufficient service space must be available for inspection and disassembly. • Keep wiring space (230 mm or more) behind the robot, and fasten the wiring to the mounting face or beam so that the weight of the cables will not be directly applied to the connectors.
Protective Earth Ground	Grounding resistance: 100 milliohms or less See Ground Point on Robot on page 23.

2.4 Transporting the Robot

Precautions when Transporting Robot

- The robot weighs almost 30 kg (66 lb). Use a crane suitable for the robot weight.
- Have at least two workers handle this job.
- Workers should wear helmets, safety shoes, and gloves during transport.

- Do not hold the first arm, elbow, either side of the 2nd arm, 2nd-axis cover, or 3rd-axis cover, or apply force to any of them. See Robot Axis Identification on page 9.



WARNING: Do not attempt to lift the robot at any points other than the eyebolts provided. Do not attempt to extend the inner or outer links of the robot until the robot has been secured in position. Failure to comply could result in the robot falling and causing either personnel injury or equipment damage.

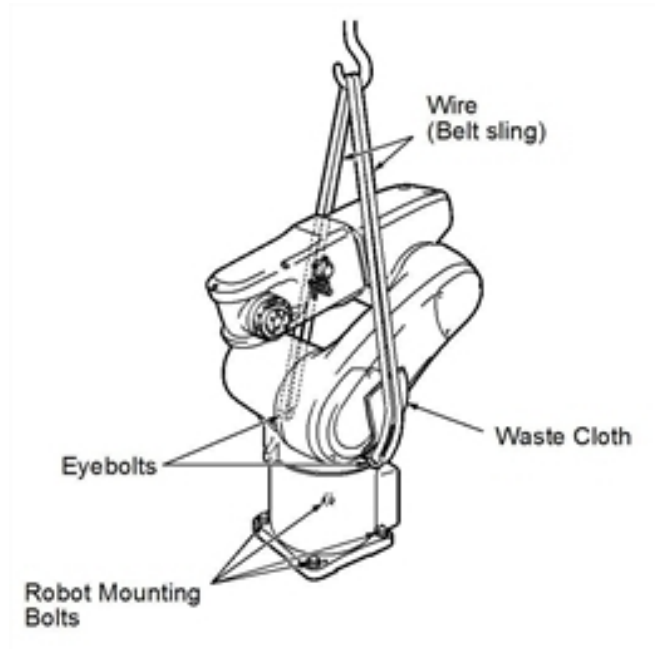
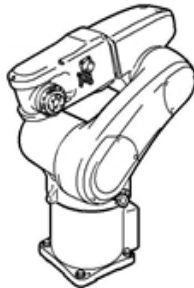
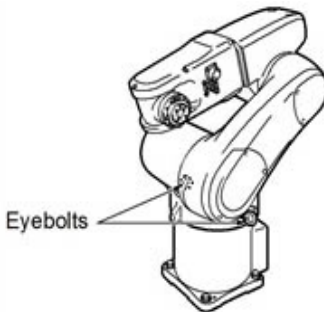
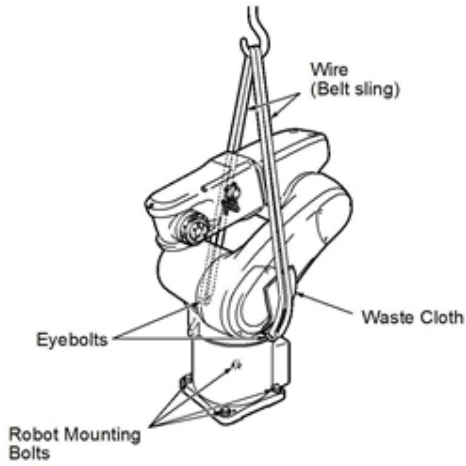


Figure 2-2. Robot in Hoisting Sling

Transport Procedure

Step	Procedure	Drawing	
1	Before transportation, set the robot in a transport position as shown at right by manually moving the second, third, and fourth axes. When initially unpacked, the robot is in the transport position, so this step is not required.		
		Transport Position	
		Axis	Angle
		First axis (J1)	0°
		Second axis (J2)	-145°
		Third axis (J3)	+243°
		Fourth axis (J4)	-90°
		Fifth axis (J5)	-90°
2	Disconnect the robot control cable, air hoses, and user signal cables from the robot. When the robot is first unpacked, this step is not required.		
3	As shown at right, mount the eye-bolts. When delivered, the robot is packed with eyebolts attached, so this step is not required		
4	As shown at right, place a waste cloth on the second axis and pass the wire through the two eyebolts. Note: Before transporting the robot, check that the path to the mounting		

Step	Procedure	Drawing
	location is free of obstacles.	 The diagram illustrates a robot being hoisted by a wire sling. The robot is positioned vertically, with its base at the bottom. A wire sling is attached to the top of the robot and extends upwards. A waste cloth is draped over the side of the robot. Eyebolts are visible on the robot's body, and robot mounting bolts are shown at the base. Labels with leader lines point to each of these components: 'Wire (Belt sling)', 'Waste Cloth', 'Eyebolts', and 'Robot Mounting Bolts'.
5	Worker A: Remove the four bolts while supporting the robot to prevent it from tipping over.	
6	Worker B: Operate the crane and move the robot to the mounting location.	
7	Worker B: Put the robot down in the mounting location. Worker A: Temporarily secure the robot base with four bolts.	
8	Secure the robot according to the instructions in Mounting the Robot on page 22.	
9	Remove the eyebolts from the robot.	Caution: Before running the robot, be sure to remove the eyebolts. Otherwise, the robot arm will strike these eyebolts.

Mounting the Robot

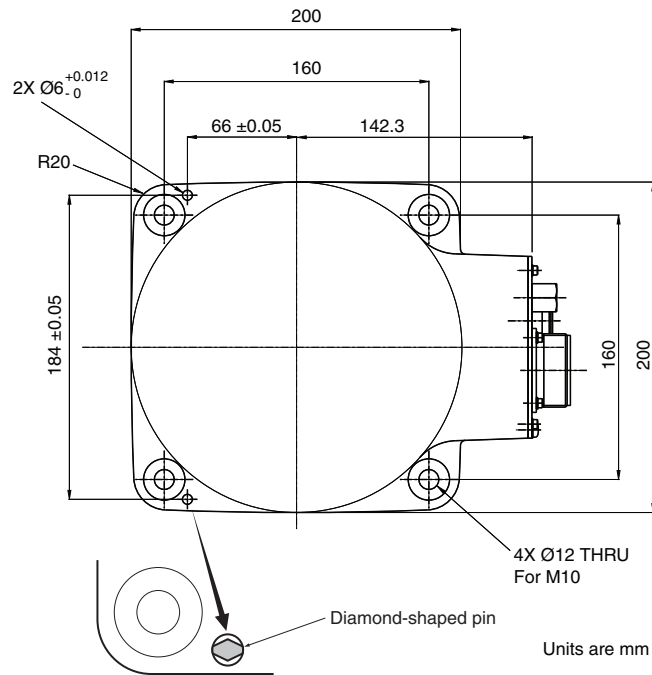


Figure 2-3. Mounting Hole Pattern for Robot

1. See the preceding figure for the dimensions of the mounting holes in the robot mounting position where the robot is to be secured.
 - Drill four bolt holes (M10), 20 mm deep or more.
 - Drill a dowel pin hole Ø6, H7 for the diamond shaped pin, 10 mm deep or more.
 - Drill a dowel pin hole Ø6, H7 for the internally threaded positioning pin, 10 mm deep or more.
2. Locate two alignment pins, one round and one diamond-shaped, supplied in the accessory kit.
3. Drive the diamond-shaped pin into one Ø6, H7 hole so that it is oriented as shown in the preceding figure.
4. Drive the internally threaded alignment pin into the other Ø6, H7 hole.

NOTE: Be sure to use the alignment pins. It can minimize positional deviations that may be caused by the removal/installation of the robot for maintenance and reduce vibration during operation.

5. Set the robot into place on the robot mount. When transporting the robot, follow the instructions given in Transporting the Robot on page 18.

6. Secure the robot to the mount with four bolts and plain washers.

- Bolt: M10 x 30 mm (strength class: 12.9)
- Tightening torque: 70 ± 14 N·m (52 ± 10 ft-lbf)

2.5 Grounding the Robot

Ground the grounding terminal of the robot with a wire of 12 AWG or larger. Ground resistance must be less than 100 milliohms.

NOTE: Use a dedicated grounding wire and grounding electrode. Do not share them with any other electric power or power equipment, such as a welder.



WARNING: Wiring must be performed by authorized or certified personnel. Failure to observe this precaution may result in fire or electric shock.

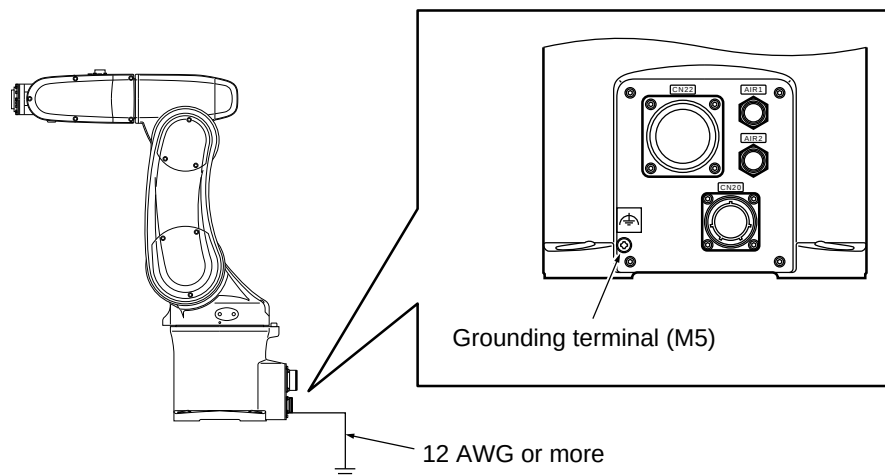


Figure 2-4. Ground Point on Robot

2.6 Description of Connectors on Robot Interface Panel

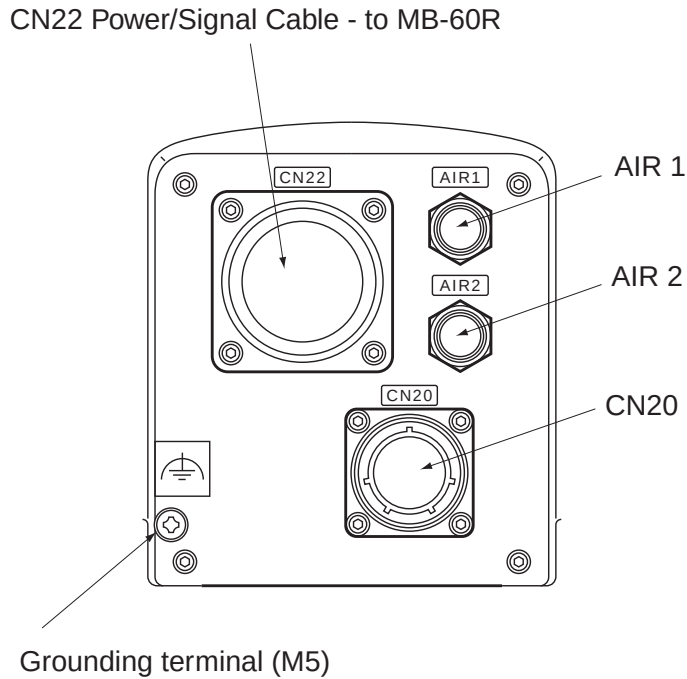


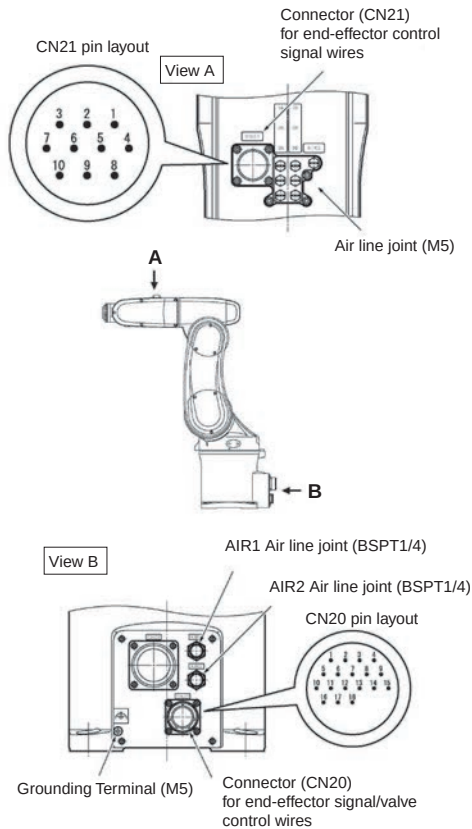
Figure 2-5. Robot Interface Panel

Table 2-2. Robot Interface Connections

CN22	The Arm Power/Signal cable from the MB-60R/eMB-60R is installed at this connector.
CN20	Pins 1 to 10 are wired directly to corresponding pins 1 to 10 on CN21 on the upper arm. Pins 12 to 18 are for solenoid control. See Air Lines and Signal Wiring on page 24.
AIR 1	Air line connector (BSPT1/4) for three solenoids in robot. Air Lines and Signal Wiring on page 24.
AIR 2	Air line connector (BSPT1/4), connects directly to AIR 2 on the second (upper) arm.
Grounding Terminal	Protective earth ground point on the robot. See Grounding the Robot on page 23.

2.7 Air Lines and Signal Wiring

The robot is equipped with seven air lines. Six lines, from AIR1 input, are controlled by the three internal solenoid valves. One line, from AIR2 input, is connected directly to AIR2 on the second arm. There are ten user electric lines. See the following figures and tables.



Note 1: Pins #1 to #10 on CN21 and those on CN20 are connected with each other. The allowable current per line is 1 A.

Note 2: Use the supplied mating connector sets for CN20 and CN21. See Cleanroom Option on page 93 for information about the mating connectors on Cleanroom and IP-54/65 robots.

Valve Symbols and Air intake/Exhaust States (1A and 1B are tubing joint symbols.)

Air tubing joining			Valve Signal		
AIR1	Air intake	Exhaust	Solenoid valve	Solenoid	
				A	B
	1A	1B	1	ON	OFF
	1B	1A	1	OFF	ON
	2A	2B	2	ON	OFF
	2B	2A	2	OFF	ON
	3A	3B	3	ON	OFF
	3B	3A	3	OFF	ON
AIR2					

CN20 Pin Assignments

NPN type (source IN, sink OUT)

CN20 pin No.	Used for:
12	+24 V
13	Solenoid 1A (solenoid valve 1)
14	Solenoid 1B (solenoid valve 1)
15	Solenoid 2A (solenoid valve 2)
16	Solenoid 2B (solenoid valve 2)
17	Solenoid 3A (solenoid valve 3)
18	Solenoid 3B (solenoid valve 3)

PNP type (sink IN, source OUT)

CN20 pin No.	Used for:
12	0 V
13	Solenoid 1A (solenoid valve 1)
14	Solenoid 1B (solenoid valve 1)
15	Solenoid 2A (solenoid valve 2)
16	Solenoid 2B (solenoid valve 2)
17	Solenoid 3A (solenoid valve 3)
18	Solenoid 3B (solenoid valve 3)

Connector set part No.	Connector No.	Model and part name	Appearance
05019-000	for CN20	SRCN6A25-24S (round type connector) Japan Aviation Electronics Industry Ltd.	
	for CN21	JMLP1610M (L type plug connector) DDK Electronics, Inc.	

Optional Solenoid Cable

An optional 4 meter solenoid cable is available that connects between the XDIO connector on the SmartController and the CN20 connector on the robot. The part number is 05739-040.

NOTE: The optional solenoid cable does not work with the IP-54/65 or the Clean-room robots.

Installing this cable allows you to control the three internal robot solenoids directly from the either the Adept ACE software, using the digital outputs, or programmatically, with V+/eV+. Refer to the following screen shots:

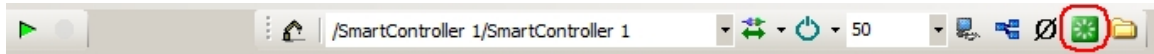


Figure 2-6. Adept ACE Digital I/O Icon

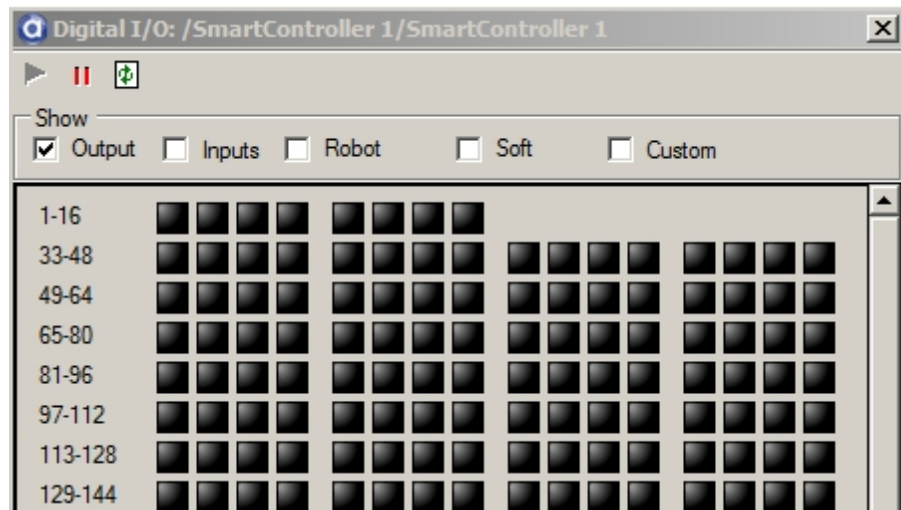


Figure 2-7. Adept ACE Digital I/O Box (Output Shown)

See the following section for the details on activating the individual ports on each solenoid.

Table 2-3. Viper Solenoid Control

	Active Output Port	Signal States ¹	
Solenoid 1	A	0001	-0002
	B	-0001	0002
Solenoid 2	A	0003	-0004
	B	-0003	0004
Solenoid 3	A	0005	-0006
	B	-0005	0006
¹ The two-position, double solenoids require both signal states to be activated. Invalid states will result in indeterminate outputs.			

In addition to controlling the internal robot solenoids, the Solenoid cable brings a portion of the other XDIO signals out to the CN21 connector at the top of the robot. See the following table for details of which signals are available at CN21. See the [Adept SmartController User's Guide](#) for the electrical specifications for the signals from the XDIO connector.

Table 2-4. CN21 Signal List When Using Solenoid Cable

CN21 Pin #	Signal from XDIO on SmartController	CN21 Pin #	Signal from XDIO on SmartController
1	Input 1001 ^a	6	Not connected
2	Input 1002 ^a	7	Output 0007 ^b
3	Input 1003 ^a	8	Output 0008 ^b
4	Input 1004 ^a	9	24 V Output ^c
5	Input 1005 ^a	10	Ground
^a Inputs 1001 to 1005 are preconfigured as low-active (sinking) inputs. ^b Outputs 0007 and 0008 are preconfigured as high-side (sourcing) outputs. ^c Limited to a combined total of 1A of current.			

Solenoid Valve Specifications

Table 2-5. Solenoid Valve Specifications

	Item	Specifications
Valve	Switching system	2-position double
	Applicable fluid	Air
	Operating system	Pilot type
	Effective cross section (Cv value)	1.2 mm ²
	Lubrication	Oilless
	Operating pressure range	0.1 to 0.7 MPa (14 to 101 psi) ^a
	Response time	15 ms or less at 0.5 MPa (72.5 psi)
	Maximum operating frequency	10 Hz
	Ambient temperature	-5 to 50° C (Dry air, non-condensing)
Solenoid	Operating voltage	24 V ±10%
	Power consumption (current)	0.5 W (21 mA)
	Surge voltage protection circuit	Zener diode
^a Note that the robot is rated at 0.1 to 0.39 MPa, 0.49 Max (14 - 56.6 psi, 71.1 Max). This upper limit is lower than the solenoid's upper limit.		

External Mounting Locations on Robot

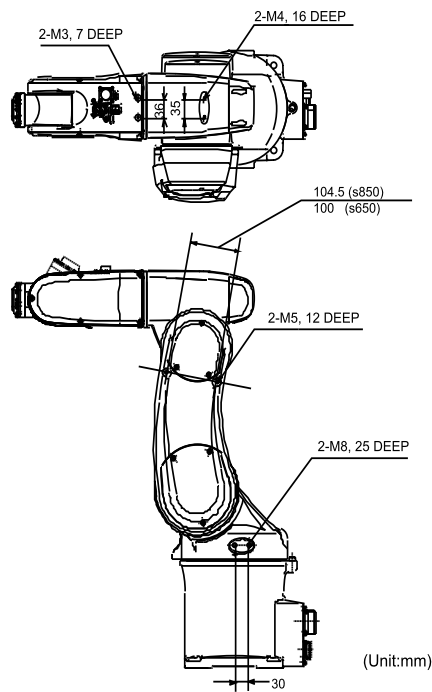


Figure 2-8. External Mounting Holes on Robot

2.8 Designing End-Effectors

Design an end-effector such that it is in compliance with items described in this section.



CAUTION: If the end-effector design precautions are not observed, the clamped parts of the robot may become loose, rattle, or be out of position. The mechanical parts of the robot and robot controller may become damaged.

Continuous Turn on J6

As an option, the Adept Viper s650/s850 can be ordered so that Joint 6 (J6) is programmed for continuous turn. Note that if J6 is programmed for continuous turn, it may lose its calibration. However, the other robot joints (J1 - J5) will not be affected.

Mass of End-Effector

Design the end-effector so that the total mass of the end-effector (including workpiece) will be lighter than the maximum payload capacity of the robot (5 kg). The total mass includes the wiring, tubing, etc.

Center of Gravity Position of End-Effector

Design an end-effector so that the center of gravity of the end-effector (including workpiece) is within the range shown in the following figure.

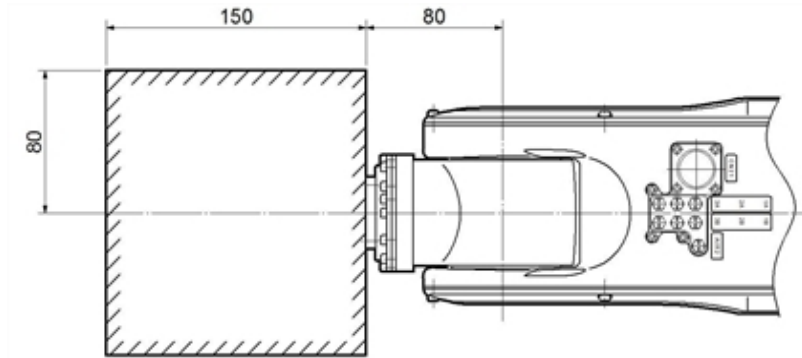


Figure 2-9. Allowable Range of Center of Gravity of End-effector

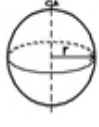
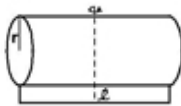
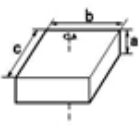
Moment of Inertia Around J4, J5, and J6

Design an end-effector so that its moments of inertia around J4, J5, and J6 (including mass of workpiece) do not exceed the maximum allowable moments of inertia of the robot.

- Maximum allowable moment of inertia around J4 and J5: 0.295 kgm^2
- Maximum allowable moment of inertia around J6: 0.045 kgm^2

When calculating the moment of inertia around J4, J5, and J6 of the end-effector, use the formulas given in the following table. See Moment of Inertia Calculation Examples on page 32.

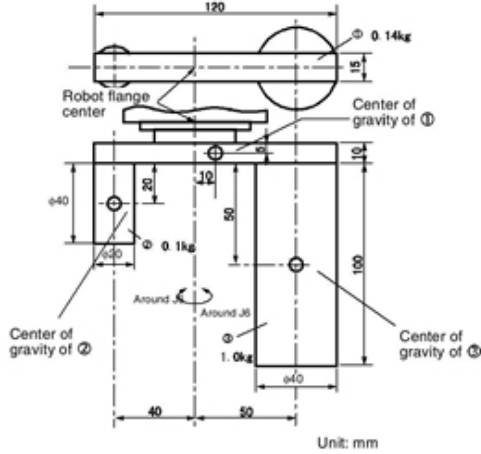
Table 2-6. Moment of Inertia Formulas

1. Cylinder (1) (Axis of rotation = Center axis)  $I = \frac{mr^2}{2}$	4. Sphere (Axis of rotation = Center axis)  $I = \frac{2mr^2}{5}$
2. Cylinder (2) (The axis of rotation passes through the center of gravity.)  $I = \frac{m}{4} \left(r^2 + \frac{l^2}{3} \right)$	5. Center of gravity not on the axis of rotation  I_G: Inertia moment around center of gravity [kgm²] $I = I_G + m\ell^2$
3. Rectangular parallelepiped (The axis of rotation passes through the center of gravity.)  $I = \frac{m}{12} (b^2 + c^2)$	I: Moment of inertia [kgm²] m: Mass [kg] r: Radius [m] b, c, ℓ: Length [m]

Calculation example : When calculating the moment of inertia of a complicated shape, divide it into simple parts as much as possible for easier calculations.

As shown in the figure below, divide the end-effector into three parts (①, ②, ③).

(1) Moment of inertia around J6



Moment of inertia around J6 of ①: I_1 (from 3 and 5 in previous table)

$$I_1 = \frac{0.14}{12} (0.12^2 + 0.015^2) + 0.14 \times 0.01^2$$

$$= 1.85 \times 10^{-4} \text{ [kgm}^2\text{]}$$

Moment of inertia around J6 of ②: I_2 (from 1 and 5 in previous table)

$$I_2 = \frac{0.1 \times 0.01^2}{2} + 0.1 \times 0.04^2$$

$$= 1.65 \times 10^{-4} \text{ [kgm}^2\text{]}$$

Moment of inertia around J6 of ③: I_3 (from 1 and 5 in previous table)

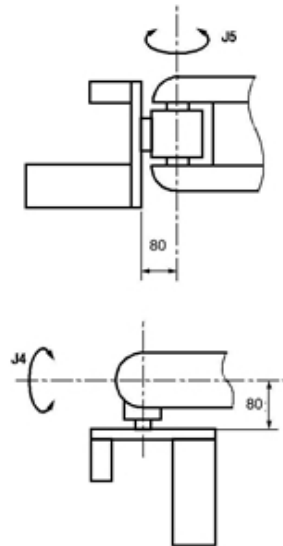
$$I_3 = \frac{1.0 \times 0.02^2}{2} + 1.0 \times 0.05^2$$

$$= 2.7 \times 10^{-3} \text{ [kgm}^2\text{]}$$

Moment of inertia around J6 of entire end-effector: I_{J6}

$$I_{J6} = I_1 + I_2 + I_3 = 0.003 \text{ [kgm}^2\text{]}$$

(2) Moment of inertia around J4 and J5



For the end-effector shown below, the moment of inertia around J4 and J5 can be calculated according to the same formula.

Moment of inertia around J4 and J5 of ①: I_1 (from 3 and 5 in previous table)

$$I_1 = \frac{0.14}{12} (0.015^2 + 0.01^2) + 0.14 \times ((0.08 + 0.005)^2 + 0.01^2)$$

$$= 1.03 \times 10^{-3} \text{ [kgm}^2\text{]}$$

Moment of inertia around J4 and J5 of ②: I_2 (from 2 and 5 in previous table)

$$I_2 = \frac{0.1}{4} \left(0.01^2 + \frac{0.04^2}{3} \right) + 0.1 \times ((0.08 + 0.01 + 0.02)^2 + 0.04^2)$$

$$= 1.39 \times 10^{-3} \text{ [kgm}^2\text{]}$$

Moment of inertia around J4 and J5 of ③: I_3 (from 2 and 5 in previous table)

$$I_3 = \frac{1.0}{4} \left(0.02^2 + \frac{0.1^2}{3} \right) + 1.0 \times ((0.08 + 0.01 + 0.05)^2 + 0.05^2)$$

$$= 2.30 \times 10^{-3} \text{ [kgm}^2\text{]}$$

Moment of inertia around J4 and J5 of entire end-effector: I_{J4}, I_{J5}

$$I_{J4} = I_{J5} = I_1 + I_2 + I_3 = 2.54 \times 10^{-2} \text{ [kgm}^2\text{]}$$

Figure 2-10. Moment of Inertia Calculation Examples

Chapter 3: MotionBlox-60R

3.1 Introduction

The Adept MotionBlox-60R (MB-60R/eMB-60R) is a distributed servo controller and amplifier. It is designed with a dedicated digital signal processor to communicate, coordinate, and execute servo commands.

The MB-60R/eMB-60R consists of:

- a distributed servo amplifier
- a RISC processor for servo loop control
- a node on the IEEE 1394 network
- a power controller that uses single-phase AC power, 200-240 Volts
- a status panel with 2-digit alpha-numeric display to indicate operating status and fault codes

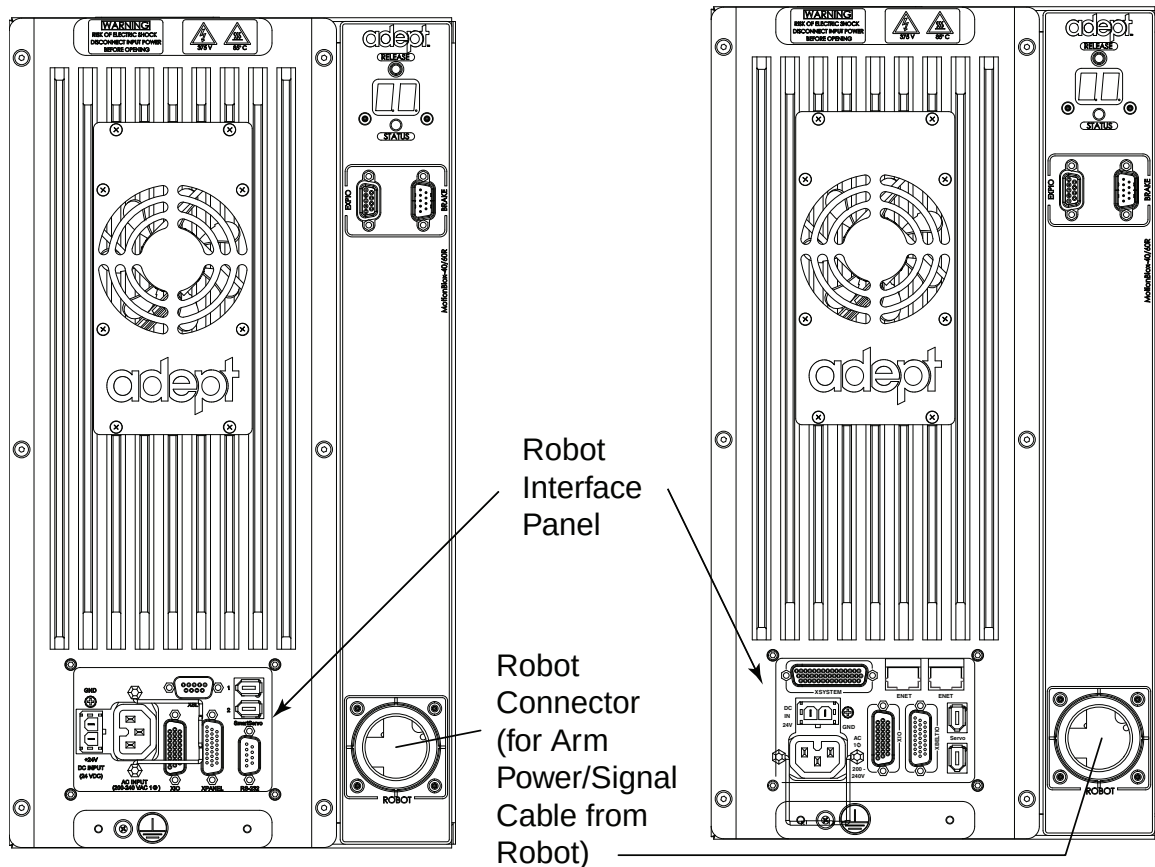


Figure 3-1. Adept MB-60R, eMB-60R

3.2 Description of Connectors on MB-60R/eMB-60R Interface Panel

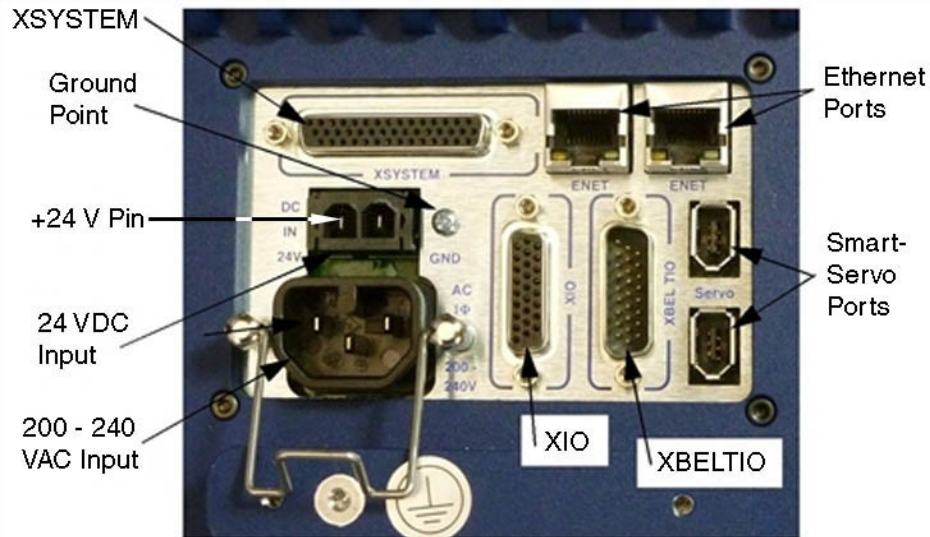


Figure 3-2. eMB-60R Interface Panel

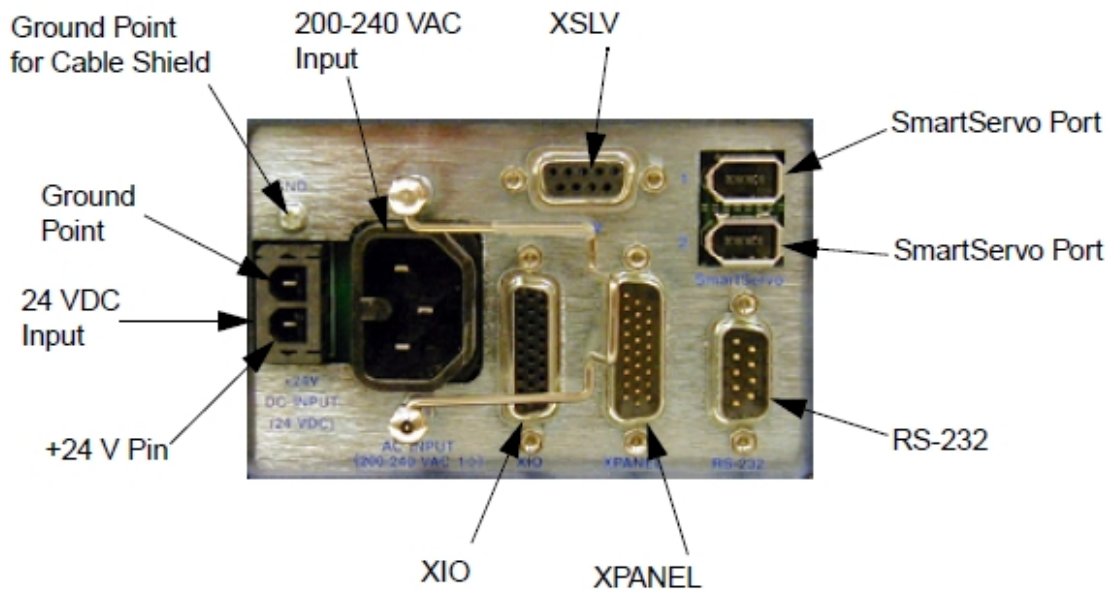


Figure 3-3. MB-60R Interface Panel

Table 3-1. Connectors on the MB-60R/eMB-60R Interface Panels

24 VDC	For connecting user-supplied 24 VDC power. The mating connector is provided.
Ground Point	For connecting cable shield from user-supplied 24 VDC cable.
200/240 VAC	For connecting 200-240 VAC, single-phase, input power. The mating connector is provided.
SmartServo	For connecting the IEEE 1394 cable from the controller. (SmartServo 1.1) to a SmartServo on the MB-60R.
XIO	For user I/O signals for peripheral devices. This connector provides 8 outputs and 12 inputs. See Connecting Digital I/O to the System on page 38 for connector pin allocations for inputs and outputs. That section also contains details on how to access these I/O signals. (DB-26, high density, female)
XSYSTEM	eMB-60R only, includes the functions of the XPANEL and XSLV on the MB-60R. Connects to the controller XSYS connector. This requires either an eAIB XSLV Adapter cable to connect to the XSYS cable, or an eAIB XSYS cable (HDB44-to-DB9, male), which replaces the XSYS cable.
ENET	eMB-60R only. Reserved for future use.
XBELTIO	eMB-60R only. Adds two belt encoders, EXPID at the back of the robot (which is not available on an AIB), and an RS-232 interface. Reserved for future use.
XSLV	MB-60R only, for connecting the supplied XSYS cable from the controller XSYS connector. (DB-9, female).
XPANEL	MB-60R only. Not used (DB-26, high density, male).
RS-232	MB-60R only. Reserved for future use (DB-9, male).

3.3 MB-60R/eMB-60R Operation

Status LED on MB-60R/eMB-60R

The Status LED Indicator is located near the top of the MB-60R/eMB-60R. See the following figure. This is a bi-color, red and green LED. The color and blinking pattern indicates the status of the robot. See the following table.

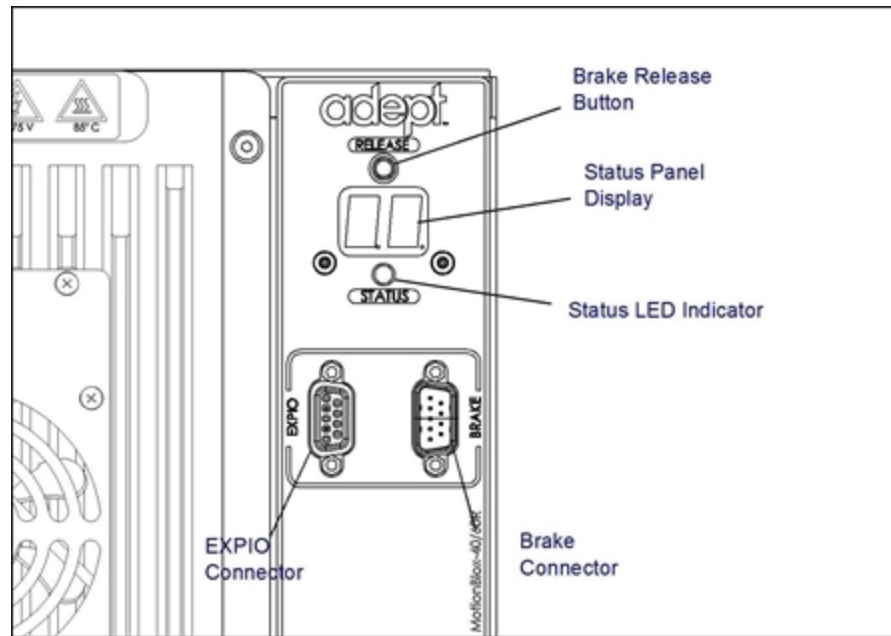


Figure 3-4. Controls and Indicators on MB-60R/eMB-60R

Table 3-2. Status LED Definition

LED Status	Description
Off	24 VDC not present
Green, Slow Blink	High Power Disabled
Green, Fast Blink	High Power Enabled
Green/Red Blink	Selected Configuration Node
Red, Fast Blink	Fault - refer to the following table
Solid Green or Red	Initialization or Robot Fault

Status Panel

The status panel, shown in the preceding figure, displays alpha-numeric codes that indicate the operating status of the MB-60R/eMB-60R, including detailed fault codes. The following table gives definitions of the fault codes. These codes provide details for quickly isolating problems during troubleshooting.

Table 3-3. Status Panel Codes

LED	Status Code	LED	Status Code
OK	No Fault	H#	High Temp Encoder (Joint #)
ON	High Power ON Status	hV	High Voltage Bus Fault
MA	Manual Mode	I#	Initialization Stage (Step #)
24	24 V Supply Fault	M#	Motor Stalled (Joint #)
A#	Amp Fault (Joint #)	NV	Non-Volatile Memory
B#	IO Blox Fault (Address #)	P#	Power System Fault (Code #)
AC	AC Power Fault	PR	Processor Overloaded
D#	Duty Cycle Exceeded (Joint #)	RC	RSC Fault
E#	Encoder Fault (Joint #)	S#	Safety System Fault (Code #)
ES	E-Stop	SE	E-Stop Delay Fault
F#	External Sensor Stop	SW	Watchdog Timeout
FM	Firmware Mismatch	T#	Safety System Fault (Code 10 + #)
FW	IEEE 1394 Fault	TR	Teach Restrict Fault
h#	High Temp Amp (Joint #)	V#	Hard Envelope Error (Joint #)

NOTE: Due to the nature of the Adept Viper s650/s850 robot's bus line encoder wiring, a single encoder wiring error may result in multiple channels of displayed encoder errors. Reference the lowest encoder number displayed.

For more information on status codes, go to the Adept Document Library on the Adept Web site, and in the Procedures, FAQs, and Troubleshooting section, look for the [Adept Status Code Summary](#) document.

Brake Release Button on MB-60R/eMB-60R

The Brake Release button is located at the top right of the MB-60R/eMB-60R. See Controls and Indicators on MB-60R/eMB-60R on page 36. When pressed, the button will disable High Power and display “BK” on the MB-60R/eMB-60R, but no brakes will be released - the Brake Release only works after an E-Stop has been pressed.

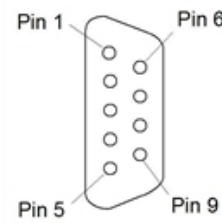
NOTE: If this button is pressed while high power is on, high power will automatically shut down.

For manual release of the brakes on the Adept Viper s650/s850 robot, a Brake Release connector is provided on the MB-60R/eMB-60R for connecting a manual brake release box. See the following section for more details. Also, an integrated brake release switch is provided on UL robots. See Brakes on page 63.

Brake Release Connector

The 9-pin Brake Release connector provides an interface for connecting a manual brake release box.

Table 3-4. Brake Release Connector Pinouts

Pin #	Description	Pin Location
1	Release1_N	 DB-9 Female Brake Connector
2	Release2_N	
3	Release3_N	
4	Release4_N	
5	Release5_N	
6	Release6_N	
7	GND	
8	Not connected	
9	24 V	
Mating Connector: D-Subminiature 9-Pin Male		

3.4 Connecting Digital I/O to the System

You can connect digital I/O to the system in several different ways. See the following table and figure.

Table 3-5. Digital I/O Connection Options

Product	I/O Capacity	For more details
XIO Connector on MB-60R/eMB-60R	12 inputs 8 outputs	see Using Digital I/O on MB-60R/eMB-60R XIO Connector on page 40
XDIO Connector on SmartController	12 inputs 8 outputs	see Adept SmartController User's Guide
Optional IO Blox Devices, connect to EXPIO connector on the MB-60R/eMB-60R	8 inputs, 8 outputs per device; up to four IO Blox devices per system	see Adept IO Blox User's Guide
Optional sDIO Module, connects to controller	32 inputs, 32 outputs per module; up to four sDIO devices per system	see Adept SmartController User's Guide

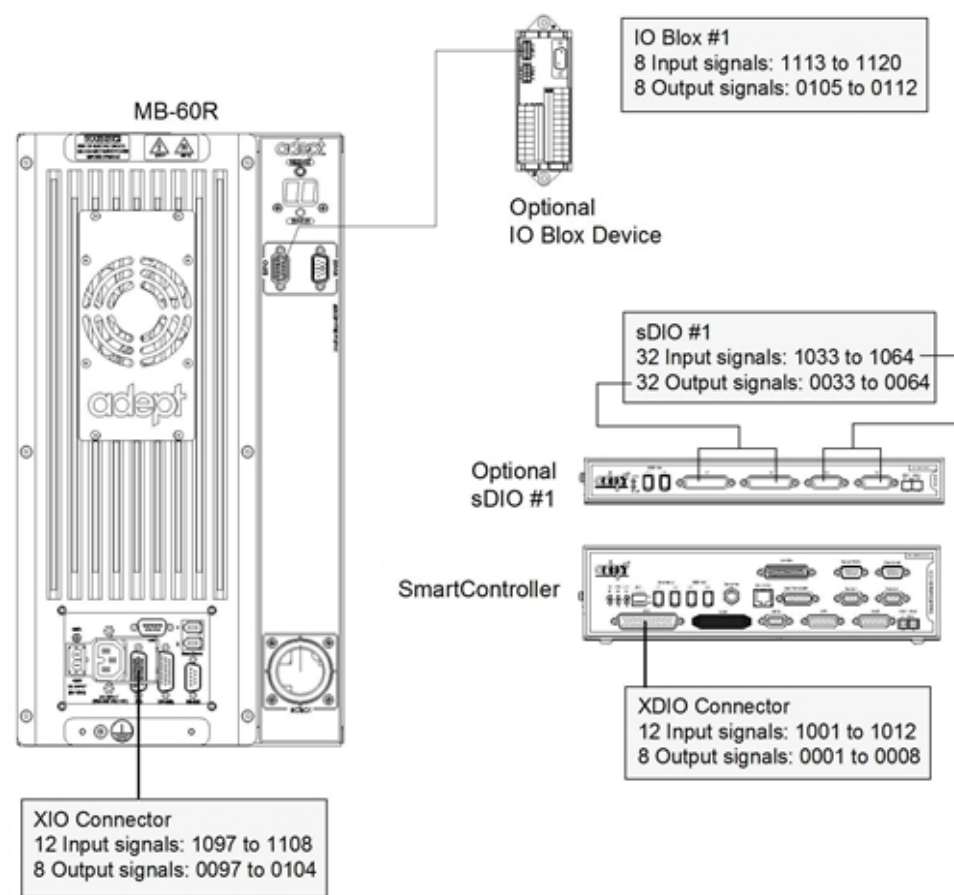


Figure 3-5. Connecting Digital I/O to the System (MB-60R and CX shown)

Table 3-6. Digital I/O Signal Ranges

	Type	Signal Range
SmartController XDIO connector	Inputs	1001 - 1012
	Outputs	0001 - 0008
sDIO Module 1	Inputs	1033 - 1064
	Outputs	0033 - 0064
sDIO Module 2	Inputs	1065 - 1096
	Outputs	0065 - 0096
MB-60R/eMB-60R XIO connector	Inputs	1097 - 1108
	Outputs	0097 - 0104
IO Blox 1	Inputs	1113 - 1120
	Outputs	0105 - 0112

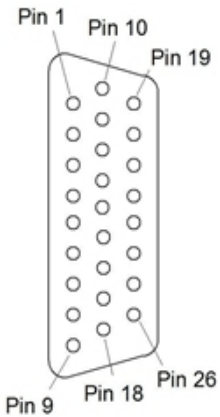
	Type	Signal Range
IO Blox 2	Inputs	1121 - 1128
	Outputs	0113 - 0120
IO Blox 3	Inputs	1129 - 1136
	Outputs	0121 - 0128
IO Blox 4	Inputs	1137 - 1144
	Outputs	0129 - 0136

3.5 Using Digital I/O on MB-60R/eMB-60R XIO Connector

The XIO connector on the MB-60R/eMB-60R interface panel offers access to digital I/O, 12 inputs and 8 outputs. These signals can be used by V+/eV+ to perform various functions in the workcell. See the following table for the XIO signal designations.

- 12 Inputs, signals 1097 to 1108
- 8 Outputs, signals 0097 to 0104

Table 3-7. XIO Signal Designations

Pin No.	Designation	Signal Bank	V+/eV+ Signal Number	Pin Locations
1	GND			 XIO 26-pin female connector on MB-60R/eMB-60R Interface Panel
2	24 VDC			
3	Common 1	1		
4	Input 1.1	1	1097	
5	Input 2.1	1	1098	
6	Input 3.1	1	1099	
7	Input 4.1	1	1100	
8	Input 5.1	1	1101	
9	Input 6.1	1	1102	
10	GND			
11	24 VDC			
12	Common 2	2		
13	Input 1.2	2	1103	
14	Input 2.2	2	1104	
15	Input 3.2	2	1105	
16	Input 4.2	2	1106	
17	Input 5.2	2	1107	
18	Input 6.2	2	1108	
19	Output 1		0097	
20	Output 2		0098	
21	Output 3		0099	
22	Output 4		0100	
23	Output 5		0101	
24	Output 6		0102	
25	Output 7		0103	
26	Output 8		0104	

Optional I/O Products

These optional products are also available for use with digital I/O:

- **XIO Breakout Cable**, 5 meters long, with flying leads on user's end. See XIO Breakout Cable on page 45 for information. This cable is not compatible with the XIO Termination Block mentioned below.
- **XIO Termination Block**, with terminals for user wiring, plus input and output status LEDs. Connects to the XIO connector with 6-foot cable. See the [Adept XIO Termination Block Installation Guide](#) for details.

XIO Input Signals

The 12 input channels are arranged in two banks of six. Each bank is electrically isolated from the other bank and is optically isolated from the MB-60R/eMB-60R ground. The six inputs within each bank share a common source/sink line.

The inputs are accessed through direct connection to the XIO connector (see the following table), or through the optional XIO Termination Block. See the documentation supplied with the Termination Block for details.

The XIO inputs cannot be used for REACTI programming, high-speed interrupts, or vision triggers. Refer to the V+/eV+ user guides in the Adept Document Library (ADL) on the Adept website. For more details on the ADL, see Adept Document Library on page 15.

XIO Input Specifications

Table 3-8. XIO Input Specifications

Parameter	Value
Operational voltage range	0 to 30 VDC
"Off" state voltage range	0 to 3 VDC
"On" state voltage range	10 to 30 VDC
Typical threshold voltage	$V_{in} = 8$ VDC
Operational current range	0 to 7.5 mA
"Off" state current range	0 to 0.5 mA
"On" state current range	2.5 to 6 mA
Typical threshold current	2.0 mA
Impedance (V_{in}/I_{in})	3.9 K Ω minimum
Current at $V_{in} = +24$ VDC	$I_{in} \leq 6$ mA
Turn on response time (hardware) Software scan rate/response time	5 μ sec maximum 16 ms scan cycle/ 32 ms max response time
Turn off response time (hardware) Software scan rate/response time	5 μ sec maximum 16 ms scan cycle/ 32 ms max response time

NOTE: The input current specifications are provided for reference. Voltage sources are typically used to drive the inputs.

Typical Input Wiring Example

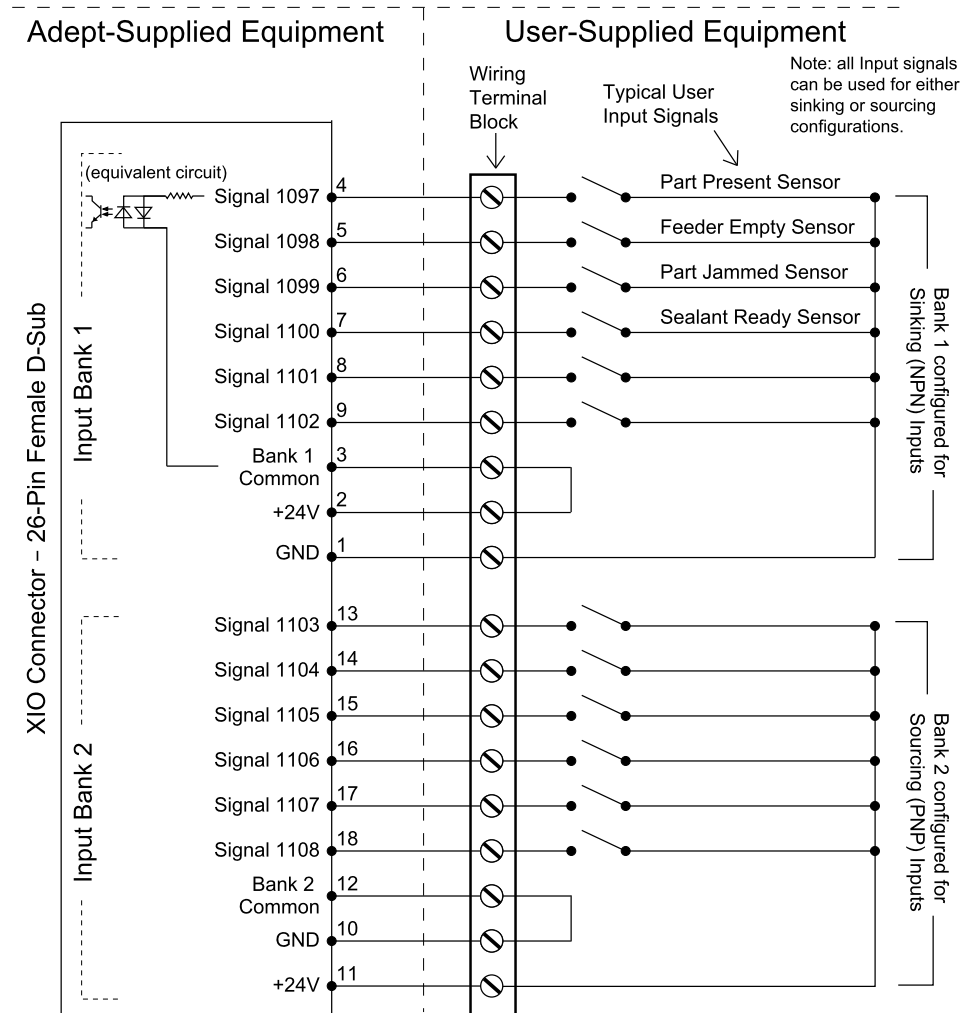


Figure 3-6. Typical User Wiring for XIO Input Signals

NOTE: The off-state current range exceeds the leakage current of XIO outputs. This guarantees that the inputs will not be turned on by the leakage current from the outputs. This is useful in situations where the outputs are looped-back to the inputs for monitoring purposes.

XIO Output Signals

The eight digital outputs share a common, high-side (sourcing) Driver IC. The driver is designed to supply any kind of load with one side connected to ground. It is designed for a range of user-provided voltages from 10 to 24 VDC and each channel is capable of up to 0.7 A of current. This driver has overtemperature protection, current limiting, and shorted load protection. In the event of an output short or other overcurrent situation, the affected output of the Driver IC turns off and back on automatically to reduce the temperature of the IC. The Driver draws power from the primary 24 VDC input to the robot through a self-resetting polyfuse.

The outputs are accessed through direct connection to the XIO connector (see Table 3-7), or through the optional XIO Termination Block. See the documentation supplied with the Termination Block for details.

XIO Output Specifications

Table 3-9. XIO Output Circuit Specifications

Parameter	Value
Power supply voltage range	See System Operation
Operational current range, per channel	$I_{out} \leq 700 \text{ mA}$
Total Current Limitation, all channels on.	$I_{total} \leq 1.0 \text{ A @ } 50^\circ \text{ C ambient}$ $I_{total} \leq 1.5 \text{ A @ } 25^\circ \text{ C ambient}$
On-state resistance ($I_{out} = 0.5 \text{ A}$)	$R_{on} \leq 0.32 \Omega @ 85^\circ \text{ C}$
Output leakage current	$I_{out} \leq 25 \mu\text{A}$
Turn-on response time	125 μsec max., 80 μsec typical (hardware only)
Turn-off response time	60 μsec . max., 28 μsec typical (hardware only)
Output voltage at inductive load turnoff ($I_{out} = 0.5 \text{ A}$, Load = 1 mH)	$(+V - 65) \leq V_{demag} \leq (+V - 45)$
DC short circuit current limit	$0.7 \text{ A} \leq I_{LIM} \leq 2.5 \text{ A}$
Peak short circuit current	$I_{ovpk} \leq 4 \text{ A}$

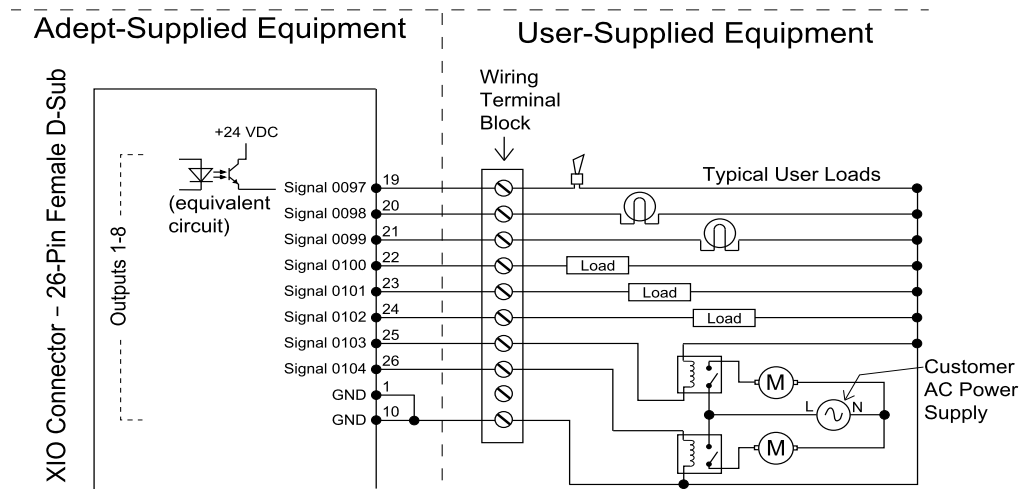
Typical Output Wiring Example

Figure 3-7. Typical User Wiring for XIO Output Signals

XIO Breakout Cable

The XIO Breakout cable is available as an option - see the following figure. This cable connects to the XIO connector on the MB-60R/eMB-60R, and provides flying leads on the user's end, for connecting input and output signals in the workcell. The part number for the cable is 04465-000, and the length is 5 M (16.4 ft).

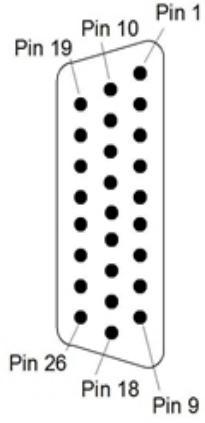
See the following table for the wire chart on the cable.

NOTE: This cable is not compatible with the XIO Termination Block.



Figure 3-8. Optional XIO Breakout Cable

Table 3-10. XIO Breakout Cable Wire Chart

Pin No.	Signal Designation	Wire Color	Pin Locations
1	GND	White	 26-pin male connector on XIO Breakout Cable
2	24 VDC	White/Black	
3	Common 1	Red	
4	Input 1.1	Red/Black	
5	Input 2.1	Yellow	
6	Input 3.1	Yellow/Black	
7	Input 4.1	Green	
8	Input 5.1	Green/Black	
9	Input 6.1	Blue	
10	GND	Blue/White	
11	24 VDC	Brown	
12	Common 2	Brown/White	
13	Input 1.2	Orange	
14	Input 2.2	Orange/Black	
15	Input 3.2	Gray	
16	Input 4.2	Gray/Black	
17	Input 5.2	Violet	
18	Input 6.2	Violet/White	
19	Output 1	Pink	
20	Output 2	Pink/Black	
21	Output 3	Light Blue	
22	Output 4	Light Blue/Black	
23	Output 5	Light Green	
24	Output 6	Light Green/Black	
25	Output 7	White/Red	
26	Output 8	White/Blue	
Shell		Shield	

3.6 MB-60R/eMB-60R Dimensions

The following figure shows dimensions of MB-60R/eMB-60R chassis and mounting holes. An MB-60R is shown, but the dimensions for the two units are the same.

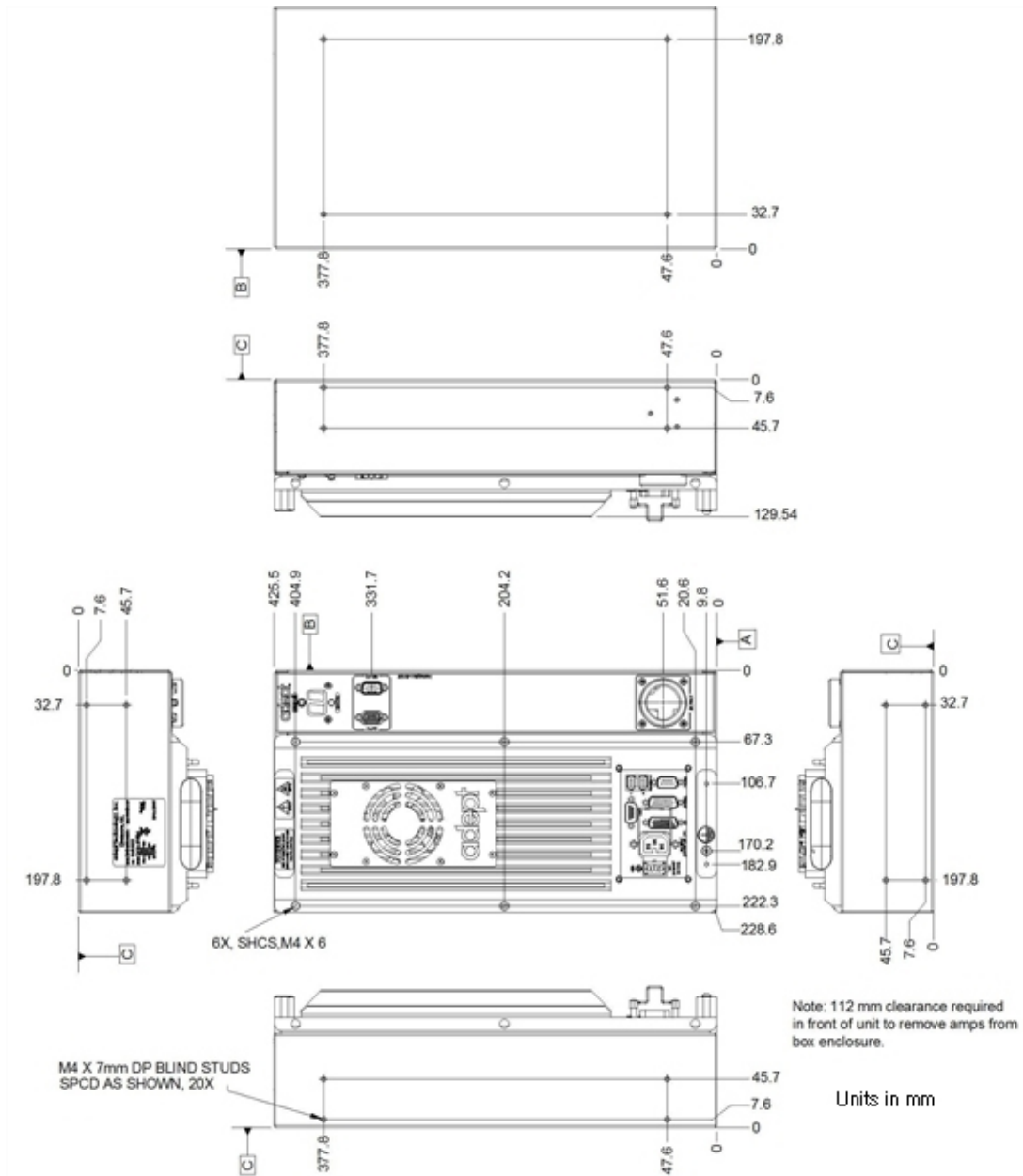


Figure 3-9. MB-60R/eMB-60R Mounting Dimensions

3.7 Mounting the MB-60R/eMB-60R

The MB-60R/eMB-60R can be panel-mounted.

NOTE: The mounting of the MB-60R/eMB-60R and all terminations at the MB-60R/eMB-60R must be performed in accordance with all local and national standards.

Panel-Mounting the MB-60R/eMB-60R

To panel-mount the MB-60R/eMB-60R, install two brackets on each side at the rear of the unit (see the following figure for the bracket dimensions). Use the screws from the accessories kit.

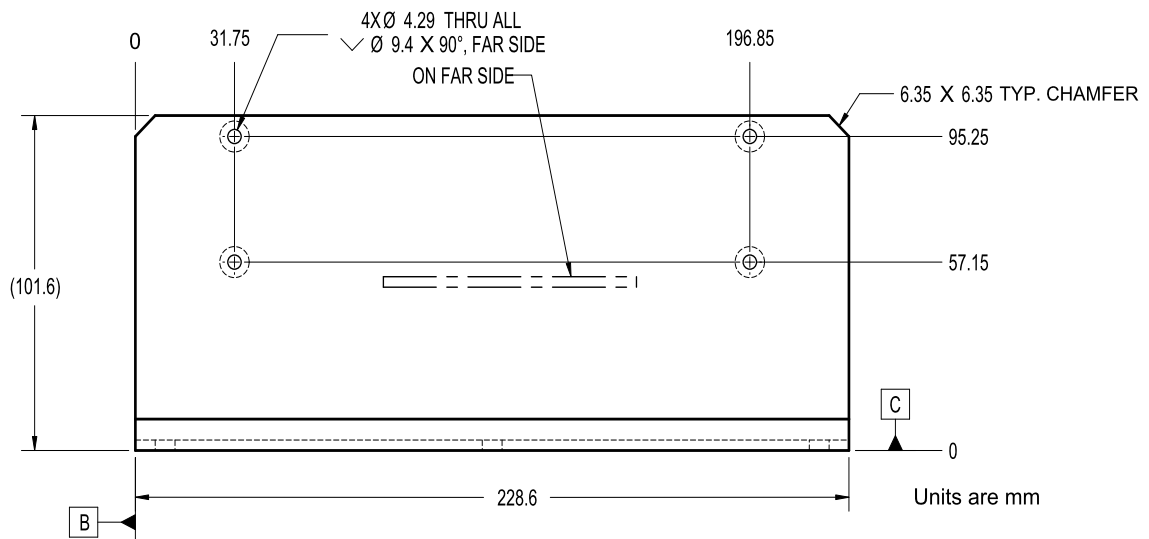


Figure 3-10. Panel-Mounting the MB-60R/eMB-60R

Chapter 4: System Installation

4.1 System Cable Diagram

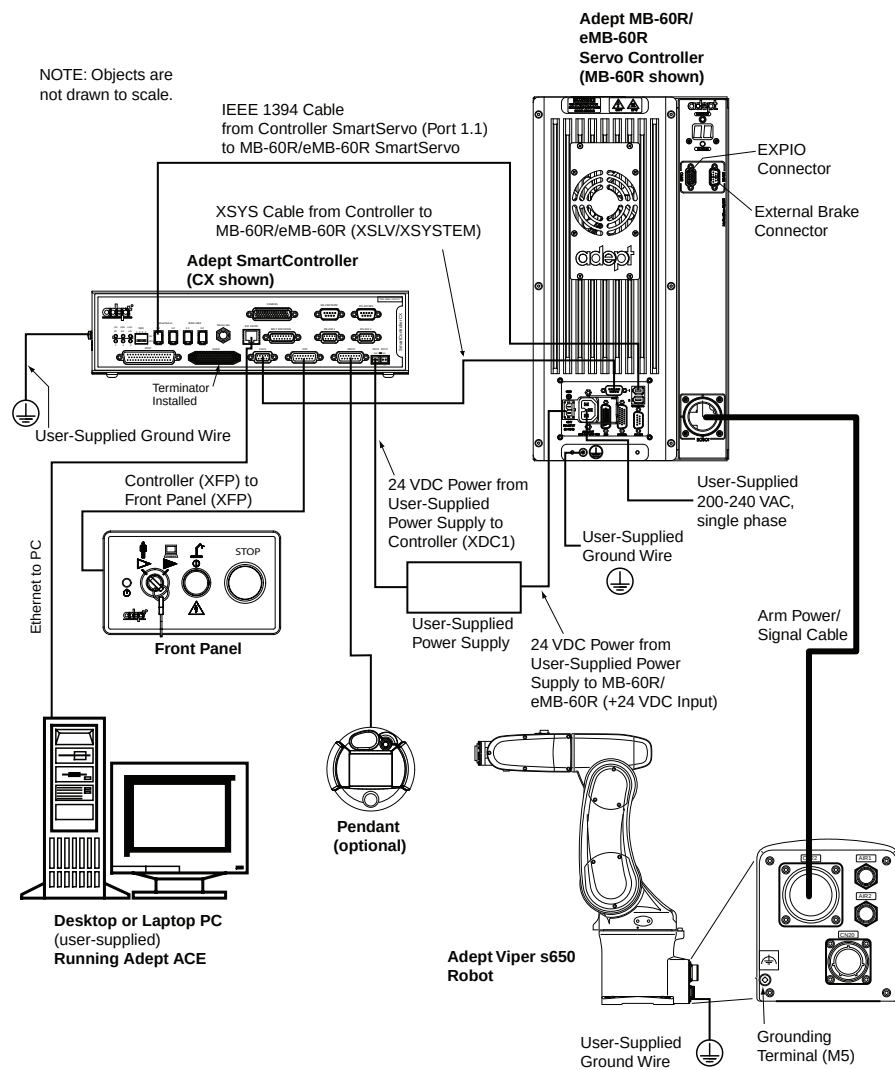


Figure 4-1. System Cable Diagram for Adept Viper s650/s850 Robots with MB-60R/eMB-60R

NOTE: See Installing the 24 VDC Cable on page 55 for additional system grounding information.

Cables and Parts List

Table 4-1. Cables and Parts List

Part Description	Notes
IEEE 1394 Cable , 4.5 M	Standard cable - supplied with system
XSYS Cable , 4.5 M (for MB-60R)	Standard cable - supplied with MB-60R
eAIB XSYS Cable , 4.5 M (for eMB-60R)	Standard cable - supplied with eMB-60R
eAIB XSLV Adapter Cable , 250 mm (for eMB-60R with old XSYS cable)	Standard for MB-60R to eMB-60R upgrade
Front Panel Cable	Supplied with Front Panel
T1/T2 Pendant Adapter Cable (for SmartController CX)	Supplied with optional T2 pendant
T20 Pendant Adapter Cable (for SmartController EX)	Supplied with optional T20 pendant
Power Cable Kit - contains 24 VDC and AC power cables	Available as option
XIO Breakout Cable , 12 inputs/8 outputs, 5 meters	Available as option - see XIO Breakout Cable on page 45
Y Cable , for XSYS cable connections to dual robots (for SmartController)	Available as option

4.2 Installing the SmartController

Refer to the [Adept SmartController User's Guide](#) for complete information on installing the Adept SmartController motion controller. This list summarizes the main steps.

1. Mount the SmartController.
2. Install the Front Panel.

The Front Panel must be outside of the work area, but near the work area.

3. Connect the Front Panel to the controller.
4. Connect the optional pendant (if purchased) to the controller.

5. Connect user-supplied 24 VDC power to the controller.

Instructions for creating the 24 VDC cable, and power specifications, are covered in the [Adept SmartController User's Guide](#).

6. Install a user-supplied ground wire between the controller and ground.
7. Install the Adept ACE software (PC user interface). Refer to the following section.

4.3 Installing the Adept ACE Software

The Adept ACE software is installed from the Adept ACE software CD-ROM.

1. Insert the CD-ROM into the CD-ROM drive of your PC.

If Autoplay is enabled, the Adept software CD-ROM menu is displayed. If Autoplay is disabled, you will need to manually start the CD-ROM.

2. Especially if you are upgrading your Adept ACE software installation: from the Adept ACE software CD-ROM menu, click Read Important Information.
3. From the Adept ACE software CD-ROM menu, select:

Install the Adept ACE Software

The Adept ACE Setup wizard opens.

4. Follow the online instructions as you step through the installation process.
5. When the installation is complete, click Finish.
6. After closing the Adept ACE Setup wizard, click Exit on the CD-ROM menu to close the menu.

NOTE: You will have to restart the PC after installing Adept ACE software.

4.4 Connecting the PC to the SmartController

The Adept SmartController motion controller must be connected to a user-supplied PC or the Adept SmartVision EX vision processor for setup, control, and programming.

- Connect an Ethernet crossover cable between the PC and the SmartController motion controller
- or
- Use two standard Ethernet cables with a network hub or switch in place of the Ethernet crossover cable.

NOTE: Do not use an Ethernet crossover cable with a network hub or switch.

For more details, refer to the [Adept ACE User's Guide](#).

4.5 Connecting Cables from the MB-60R/eMB-60R to the Smart-Controller

1. Locate the IEEE 1394 cable (length 4.5 M) and the XSYS or eAIB XSYS cable (length 4.5 M). They are shipped in the cable/accessories box.
2. Install one end of the IEEE 1394 cable into the SmartServo connector on the Smart-Controller (port 1.1 for CX, either for EX), and install the other end into a SmartServo connector on the MB-60R/eMB-60R interface panel. See System Cable Diagram for Adept Viper s650/s850 Robots with MB-60R/eMB-60R on page 49. Make sure the plug is oriented correctly to the connector.
3. MB-60R: Install the XSYS cable between the XSYS connector on the SmartController and the MB-60R XSLV safety interlock connector, and tighten the latching screws.

eMB-60R: Install the eAIB XSYS cable between the XSYS connector on the Smart-Controller and the eMB-60R XSYSTEM connector, and tighten the latching screws.

If you are upgrading from an MB-60R to an eMB-60R, you can use an eAIB XSLV Adapter cable between your existing XSYS cable and the XSYSTEM connector on the new eMB-60R.

NOTE: The IEEE 1394 and XSYS/eAIB XSYS cables should be routed away from AC power and robot interconnect cables.

4.6 Connecting Cables from the MB-60R/eMB-60R to the Robot

Installing the Arm Power/Signal Cable

The cable between the robot and the MB-60R/eMB-60R is called the Arm Power/Signal cable.

1. Connect one end of the Arm Power/Signal cable to the CN22 connector on the back plate of the robot. Tighten the thumb-screw securely.
2. Connect the other end of the cable to the large, circular connector on the MB-60R/eMB-60R. See System Cable Diagram for Adept Viper s650/s850 Robots with MB-60R/eMB-60R on page 49.



WARNING: Verify that all connectors are fully-inserted and screwed down. Failure to do this could cause unexpected robot motion. Also, a connector could get pulled out or dislodged unexpectedly.

4.7 Connecting 24 VDC Power to MB-60R/eMB-60R Servo Controller

Specifications for 24 VDC Power

Table 4-2. Specifications for 24 VDC User-Supplied Power Supply

Customer-Supplied Power Supply	24 VDC ($\pm 10\%$), 150 W (6 A) ($21.6\text{ V} < V_{in} < 26.4\text{ V}$)
Circuit Protection ¹	Output must be less than 300 W peak or 8 Amp in-line fuse
Power Cabling	1.5 – 1.85 mm ² (16-14 AWG)
Shield Termination	Cable shield connected to frame ground on power supply and ground point on MB-60R/eMB-60R. See User-Supplied 24 VDC Cable on page 55.
¹ User-supplied 24 VDC power supply must incorporate overload protection to limit peak power to less than 300 W, or 8 A in-line fuse protection must be added to the 24 V power source.	

NOTE: Fuse information is located on the MB-60R/eMB-60R electronics.

The power requirements for the user-supplied power supply will vary depending on the configuration of the robot and connected devices. Adept recommends a 24 V, 6 A power supply to allow for startup current draw and load from connected user devices, such as digital I/O loads.



CAUTION: Make sure you select a 24 VDC power supply that meets the specifications in the preceding table. Using an underrated supply can cause system problems and prevent your equipment from operating correctly. See the following table for recommended power supplies.

Table 4-3. Recommended 24 VDC Power Supplies

Vendor Name	Model	Ratings
XP Power	JPM160PS24	24 VDC, 6.7 A, 160 W
Mean Well	SP-150-24	24 VDC, 6.3 A, 150 W
Astrodyne	ASM150-24	24 VDC, 6.66 A, 150 W

Details for 24 VDC Mating Connector

The 24 VDC mating connector and two pins are supplied with each system. They are shipped in the cable/accessories box.

Table 4-4. 24 VDC Mating Connector Specs

Connector Details 	Connector receptacle, 2 position, type: Molex Saber, 18 A, 2-Pin
	Molex P/N 44441-2002
	Digi-Key P/N WM18463-ND
Pin Details 	Molex connector crimp terminal, female, 14-18 AWG
	Molex P/N 43375-0001
	Digi-Key P/N WM18493-ND
Recommended crimping tool, Molex Hand Crimper	Molex P/N 63811-0400
	Digi-Key P/N WM9907-ND

NOTE: The 24 VDC cable is not supplied with the system, but is available in the optional Power Cable kit. See Cables and Parts List on page 50.

Procedure for Creating 24 VDC Cable

1. Locate the connector and pins from the preceding table.
2. Use shielded two-conductor cable with 14-16 AWG wire to create the 24 VDC cable. Select the wire length to safely reach from the user-supplied 24 VDC power supply to the MB-60R/eMB-60R base.

NOTE: You also must create a separate 24 VDC cable for the Smart-Controller. That cable uses a different style of connector. See the [Adept Smart-Controller User's Guide](#).

3. Crimp the pins onto the wires using the recommended crimping tool.
4. Insert the pins into the connector. Confirm that the +24 V and ground wires are in the correct terminals in the plug.
5. Install a user-supplied ring lug (for an M3 screw) on the shield at the MB-60R/eMB-60R end of the cable.
6. Prepare the opposite end of the cable for connection to the user-supplied 24 VDC power supply, including a terminal to attach the cable shield to frame ground.

Installing the 24 VDC Cable

Do not turn on the 24 VDC power until instructed to do so in the next chapter.

1. Connect one end of the shielded 24 VDC cable to your user-supplied 24 VDC power supply. See User-Supplied 24 VDC Cable on page 55. The cable shield should be connected to frame ground on the power supply.
2. Plug the mating connector end of the 24 VDC cable into the 24 VDC connector on the interface panel on the back of the MB-60R/eMB-60R. The cable shield should be connected to the ground point on the interface panel.

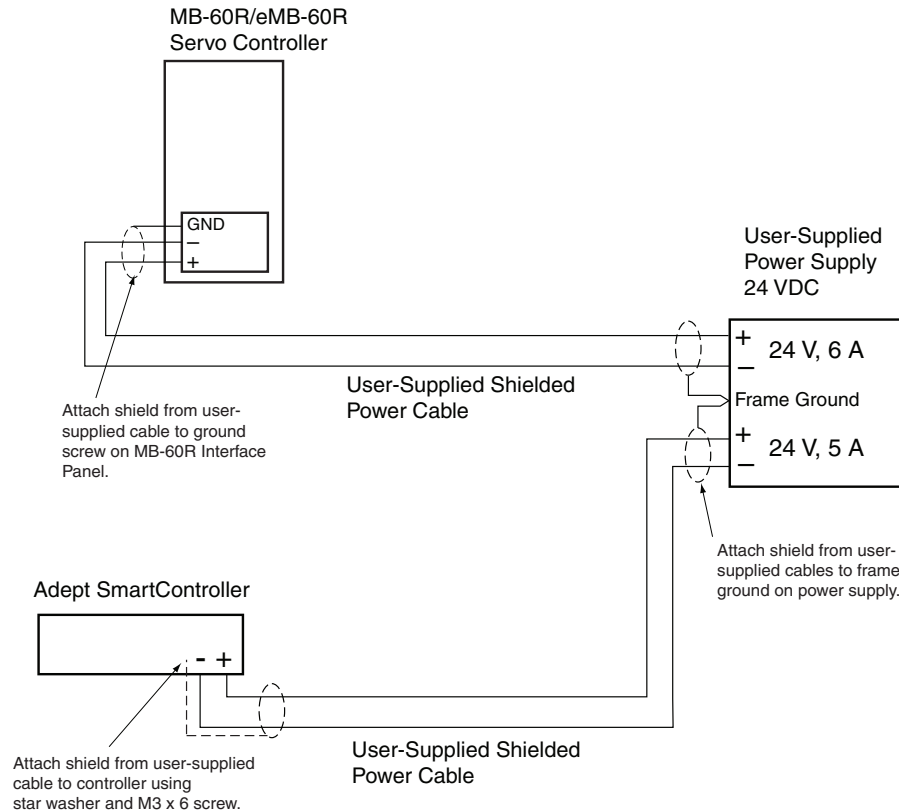


Figure 4-2. User-Supplied 24 VDC Cable

NOTE: Adept recommends that DC power be delivered over shielded cables, with the shield connected to frame ground at the power supply, and to the ground points shown in the diagram above for the MB-60R/eMB-60R and SmartController. The length of the wire from the cable shield to the ground points should be less than 50 mm.

4.8 Connecting 200-240 VAC Power to MB-60R/eMB-60R



WARNING: Ensure compliance with all local and national safety and electrical codes for the installation and operation of the robot system.



WARNING: Appropriately-sized Branch Circuit Protection and Lockout / Tagout Capability must be provided in accordance with the National Electrical Code and any local codes.

Specifications for AC Power

Table 4-5. Specifications for 200/240 VAC User-Supplied Power Supply

Auto-Ranging Nominal Voltage Ranges	Minimum Operating Voltage ¹	Maximum Operating Voltage	Frequency / Phasing	Recommended External Circuit Breaker, User-Supplied
200 to 240 V	180 V	264 V	50/60 Hz 1-phase	10 Amps
¹ Specifications are established at nominal line voltage. Low line voltage can affect robot performance.				

The Adept robot system is intended to be installed as a piece of equipment in a permanently-installed system.

Table 4-6. Typical Robot Power Consumption¹

Robot	Move	Average Power (W)	Peak Power (W) ²
Adept Viper s650	No load - Adept cycle ³	371	947
	5.0 kg - Adept cycle ³	477	1526
	5.0 kg - all joints move	834	2088
Adept Viper s850	No load - Adept cycle ³	358	1237
	5.0 kg - Adept cycle ³	407	1202
	5.0 kg - all joints move	704	2090
¹ Typical power data is with 220 VAC, 60 Hz, 1-phase nominal input. ² For short durations (100 ms). ³ Adept cycle: the robot tool per over, 25 mm down, and backforms continuous path, straight-line motions 25 mm up, 305 mm along the same path. COARSE is enabled and BREAKs are used at each end location. Not achievable over all paths.			



DANGER: AC power installation must be performed by a skilled and instructed person - refer to the [Adept Robot Safety Guide](#). During installation, unauthorized third parties must be prevented from turning on power through the use of fail-safe lockout measures.

Facility Overvoltage Protection

The user must protect the robot from excessive overvoltages and voltage spikes. If the country of installation requires a CE-certified installation, or compliance with IEC 1131-2, the following information may be helpful: IEC 1131-2 requires that the installation must ensure that Category II overvoltages (i.e., line spikes not directly due to lightning strikes) are not exceeded. Transient overvoltages at the point of connection to the power source shall be controlled not to exceed overvoltage Category II, i.e., not higher than the impulse voltage corresponding to the rated voltage for the basic insulation. The user-supplied equipment or transient suppressor shall be capable of absorbing the energy in the transient.

In the industrial environment, nonperiodic over-voltage peaks may appear on mains power supply lines as a result of power interruptions to high-energy equipment (such as a blown fuse on one branch in a 3-phase system). This will cause high-current pulses at relatively low voltage levels. The user shall take the necessary steps to prevent damage to the robot system (such as by interposing a transformer). See IEC 1131-4 for additional information.

AC Power Diagrams

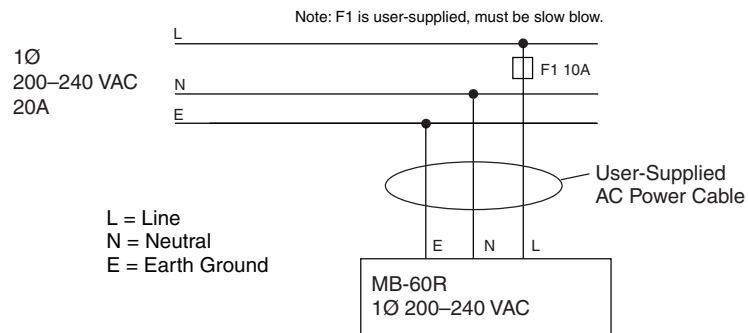


Figure 4-3. Typical AC Power Installation with Single-Phase Supply

Chapter 4: System Installation

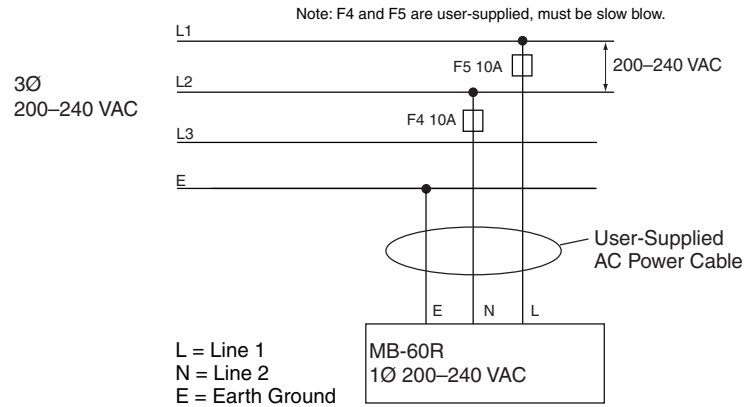
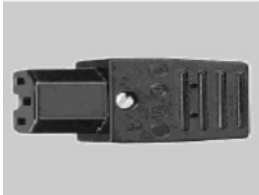


Figure 4-4. Single-Phase Load across L1 and L2 of a Three-Phase Supply

Details for AC Mating Connector

The AC mating connector is supplied with each system. It is shipped in the cable/accessories box. The supplied plug is internally labeled for the AC power connections (L, E, N).

Table 4-7. AC Mating Connector Details

AC Connector details 	AC in-line power plug, straight, female, screw terminal, 10 A, 250 VAC
	Qualtek P/N 709-00/00
	Digi-Key P/N Q217-ND

NOTE: The AC power cable is not supplied with the system, but is available in the optional Power Cable kit.

Procedure for Creating 200-240 VAC Cable

1. Locate the AC mating connector shown in the preceding table.
2. Open the connector by unscrewing the screw on the shell and removing the cover.
3. Loosen the two screws on the cable clamp. See AC Power Mating Connector on page 59.
4. Use 18 AWG wire to create the AC power cable. Select the wire length to safely reach from the user-supplied AC power source to the MB-60R/eMB-60R base.
5. Strip approximately 18 to 24 mm of insulation from each of the three wires.
6. Insert the wires into the connector through the removable bushing.

7. Connect each wire to the correct terminal screw, and tighten the screw firmly.
8. Tighten the screws on the cable clamp.
9. Replace the cover and tighten the screw to seal the connector.
10. Prepare the opposite end of the cable for connection to the facility AC power source.

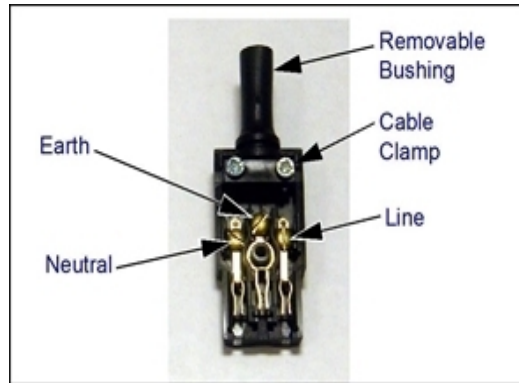


Figure 4-5. AC Power Mating Connector

Installing AC Power Cable to MB-60R/eMB-60R

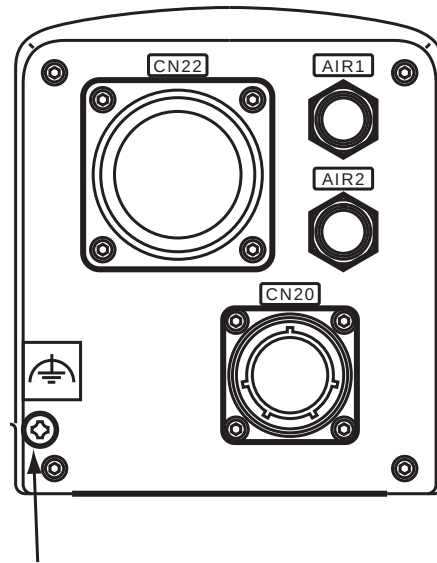
1. Connect the unterminated end of the AC power cable to your facility AC power source. See Figure 4-3. and Figure 4-4.
Do not turn on AC power at this time.
2. Plug the AC connector into the AC power connector on the interface panel on the MB-60R/eMB-60R.
3. Secure the AC connector with the locking latch.

4.9 Grounding the Adept Robot System

Proper grounding is essential for safe and reliable robot operation. Follow these recommendations to properly ground your robot system.

Ground Point on Robot Base

The user can install a protective earth ground wire at the robot base to ground the robot. See the following figure. The user is responsible for supplying the ground wire to connect to protective earth ground.



Grounding
Terminal (M5)

Figure 4-6. Ground Point on Robot Base

Ground Point on MotionBlox-60R

The user can install a ground wire at the MB-60R/eMB-60R chassis. Use the hole below the MB-60R/eMB-60R interface panel. See the following figure. The user should provide a ground wire and use the provided M4 screw and external tooth lock washer to connect to earth ground. Make sure to tighten the screw on the ground wire to create a proper ground connection. Optionally, two tapped holes are provided to attach user-supplied strain relief.

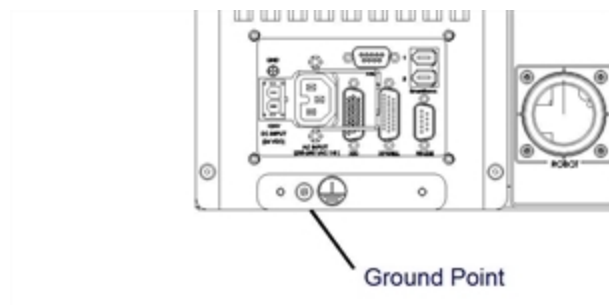


Figure 4-7. User Ground Location, MB-60R Shown

Robot-Mounted Equipment Grounding

The robot tool flange is not reliably grounded to the robot base. If hazardous voltages are present at any user-supplied robot-mounted equipment or tooling, you must install a ground connection from that equipment/tooling to the ground point on the robot base. Hazardous voltages can be considered anything in excess of 30 VAC (42.4 VAC peak) or 60 VDC.



DANGER: Failing to ground robot-mounted equipment or tooling that uses hazardous voltages could lead to injury or death of a person touching the end-effector when an electrical fault condition exists.

4.10 Installing User-Supplied Safety Equipment

The user is responsible for installing safety barriers to protect personnel from coming in contact with the robot unintentionally. Depending on the design of the workcell, safety gates, light curtains, and emergency stop devices can be used to create a safe environment. Read the [Adept Robot Safety Guide](#) for a discussion of safety issues.

Refer to the [Adept SmartController User's Guide](#) for information on connecting safety equipment into the system through the XUSR connector on the SmartController. There is a detailed section on Emergency Stop circuits and diagrams on recommended E-Stop configurations.

Chapter 5: System Operation

5.1 Status Panel Codes

The status panel display on the MB-60R/eMB-60R displays alpha-numeric codes that indicate the operating status of the robot, including detailed fault codes. The chapter on MotionBlox-60R gives definitions of the fault codes. These codes provide details for quickly isolating problems during troubleshooting. See Status Panel on page 36

For more information on status codes, go to the Adept Document Library on the Adept web site, and in the Procedures, FAQs, and Troubleshooting section, look for the [Adept Status Code Summary](#) document.

5.2 Brakes

UL robots have an integrated brake-release switch located on the robot. On non-UL robots, you can install a manual brake-release box. In both cases, you can release the brakes on a specific axis.



WARNING: Secure the robot prior to releasing the brakes on axes 2 or 3, to prevent injury to personnel or equipment damage.

Installing and Using the Brake Release Box

This procedure describes how to install and use a manual brake release box on non-UL robots. See Manual Brake-Release Box on page 64.

1. Make sure that high power is disabled (off).
2. Connect the 9-pin male D-sub connector into the 9-pin female D-sub connector marked Brake on the MB-60R/eMB-60R.
3. Press one of the E-Stops (Pendant, Front Panel, or external).

NOTE: An E-Stop must be activated in order for the brake release box to work.

4. Using the axis selector switch, select the axis on which you want to release the brake.
5. Depress the Brake Release push button to release the brake.
6. Repeat steps 4 and 5 above for releasing the brakes on another axis.

NOTE: When the Status LED (Green) is on, it indicates that the circuit is enabled, when the Brake Release push button is pressed.

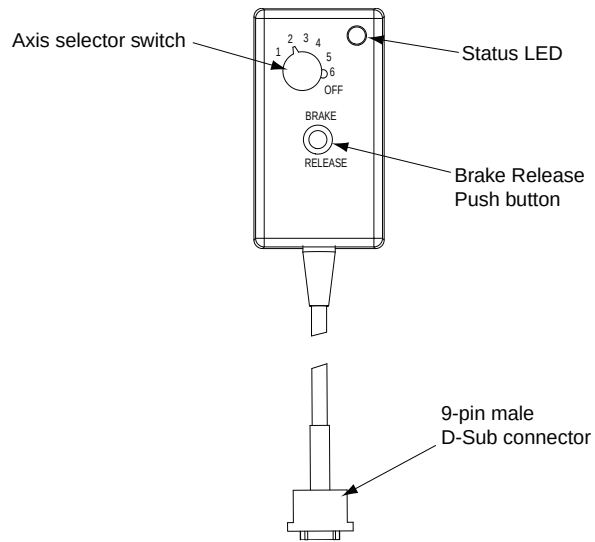


Figure 5-1. Manual Brake-Release Box

Using the Brake Release Switch on UL Robots

This procedure describes how to use the brake release switch on the base of UL robots. See the following figure.

1. Make sure that high power is disabled (off).
2. Press one of the E-Stops (Pendant, Front Panel, or external).

NOTE: An E-Stop must be activated in order for the brake release to work.

3. Using the axis selector switch, select the axis on which you want to release the brake.
4. Depress the Brake Release push button, to release the brake.
5. Repeat steps 3 and 4 above to release the brakes on another axis.

NOTE: When the Status LED (Green) is on, it indicates that the circuit is enabled, when the Brake Release push button is pressed.



Figure 5-2. Brake Release Switch on UL Robots

5.3 Starting the System for the First Time

The first time you power-up the system, you must follow the steps in this section to safely bring up your robot system. The tasks include:

- Verifying installation, to confirm all tasks have been performed correctly.
- Starting up the system by turning on power for the first time.
- Verifying all E-Stops in the system function correctly.
- Moving each axis of the robot (typically with the pendant) to confirm it moves in the proper directions.

Verifying Installation

Verifying that the system is correctly installed and that all safety equipment is working correctly is an important process. Before using the robot, make the following checks to ensure that the robot and controller have been properly installed.



DANGER: After installing the robot, you must test it before you use it for the first time. Failure to do this could cause death, serious injury or equipment damage.

Mechanical Checks

- Verify that the robot is mounted level and that all fasteners are properly installed and tightened.
- Verify that any end-of-arm tooling is properly installed.
- Verify that all other peripheral equipment is properly installed and in a state where it is safe to turn on power to the robot system.

System Cable Checks

Verify the following connections:

- Front Panel to the SmartController.
- Optional pendant to the SmartController.
- User-supplied 24 VDC power to the controller.
- User-supplied ground wire between the SmartController and ground.
- One end of the IEEE 1394 cable into the SmartServo port connector on the SmartController (1.1 for the CX, any for the EX), and the other end into the SmartServo connector on the MB-60R/eMB-60R.
- MB-60R: XSYS cable between the XSYS connector on the SmartController and the MB-60R XSLV safety interlock connector, and latching screws are tight.
- eMB-60R: eAIB XSYS cable between the XSYS connector on the SmartController and the

eMB-60R XSYSTEM safety interlock connector, and latching screws are tight.
or XSYS cable into an eAIB XSLV Adapter, into the eMB-60R XSYSTEM connector.

- User-supplied 24 VDC power to the MB-60R/eMB-60R 24 VDC connector.
- User-supplied 200/240 VAC power to the MB-60R/eMB-60R 200/240 VAC connector.

User-Supplied Safety Equipment Checks

Verify that all user-supplied safety equipment and E-Stop circuits are installed correctly.

System Start-up Procedure

Once the system installation has been verified (see Verifying Installation on page 65), you are ready to start up the system.

1. Switch on AC power to the MB-60R/eMB-60R.
2. Switch on the 24 VDC power to the controller and the MB-60R/eMB-60R.
3. Follow the instructions, beginning with Starting the Adept ACE Software, in the following section.

Running the Adept ACE Software

Starting the Adept ACE Software

The robot should be on, and the status panel should display OK before proceeding.

1. Turn on the PC and start the Adept ACE software.
 - Double-click the Adept ACE icon on your Windows desktop
or, from the Windows Start menu bar,
 - Select **Start > Programs > Adept Technology > Adept ACE > Adept ACE**.
2. On the Adept ACE Startup menu, click New SmartController Workspace.
3. Click-select the SmartController you want to use, and click OK.

Enabling High Power

After you have started the Adept ACE software and connected to the controller, enable high power to the robot motors:

1. From the Adept ACE main menu, click the Enable High Power icon: 
2. If the High Power button on the Front Panel is blinking, press and release it.

NOTE: The use of the blinking High Power button can be configured (or eliminated) in software. Your system may not require this step.

The Front Panel, which is mounted just outside the workcell safety barrier, is shown in the following figure. If enabled, the High Power button must be pressed while blinking

(default time-out is 10 seconds). If the button stops blinking, you must enable power again.

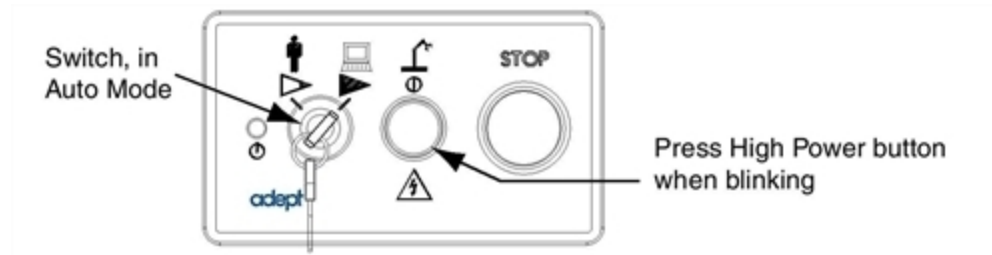


Figure 5-3. High Power Button on Front Panel

This step turns on high power to the robot motors and calibrates the robot.

- The amplifier status LED blinks green rapidly (a slow green blink has a different meaning).

In addition, for Adept IP-65 Viper robots, the lamps on the robot glow solid amber.

- The status panel on the robot or amplifier chassis displays ON.

Verifying E-Stop Functions

Verify that all E-Stop devices are functional (pendant, Front Panel, and user-supplied). Test each mushroom button, safety gate, light curtain, etc., by enabling high power and then opening the safety device. The High Power push button/light on the Front Panel should go out.

Verify Robot Motions

Use the pendant (or jog control) to test the motion of each axis on the robot to confirm it moves in the proper directions.

Refer to the [Adept T20 Pendant User's Guide](#) or the [Adept T2 Pendant User's Guide](#) for instructions on using the pendant.

If the optional pendant is not installed in the system, you can move the robot using the Robot Jog Control in the Adept ACE software. For details, see the [Adept ACE User's Guide](#).

NOTE: When using a pendant with an Adept Viper robot, the Free mode is disabled for safety reasons.

5.4 Learning to Program the Robot

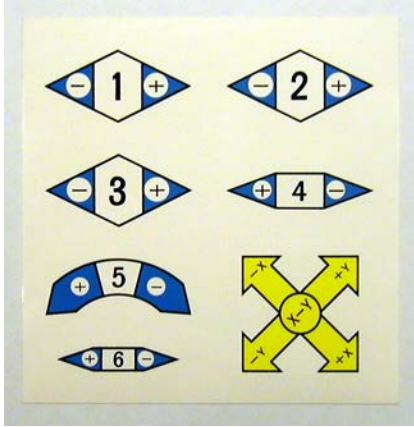
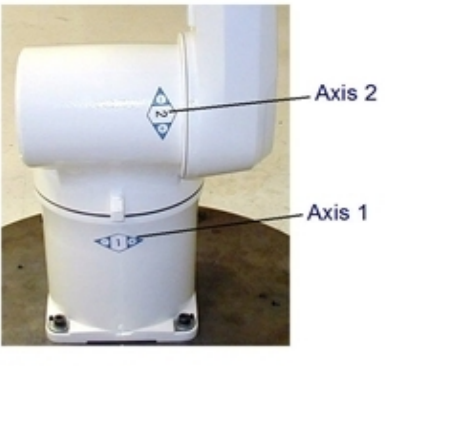
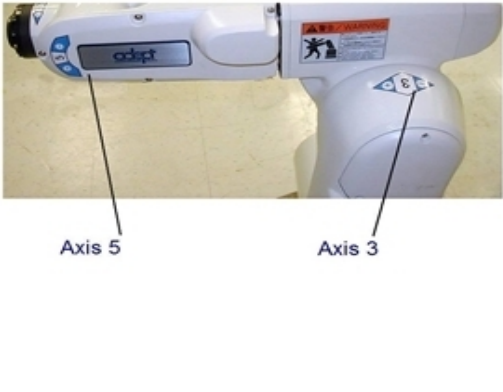
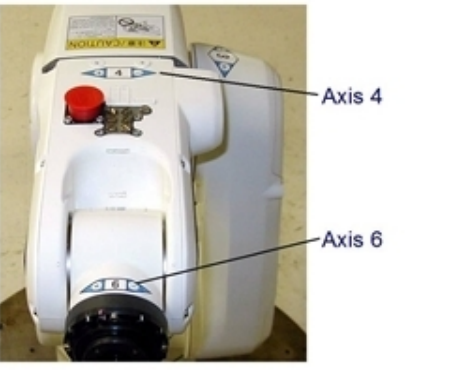
To learn how to use and program the robot, see the [Adept ACE User's Guide](#), which provides information on robot configuration, control and programming through the Adept ACE software "point and click" user interface.

For V+/eV+ programming information, refer to the V+/eV+ user and reference guides in the Adept Document Library (ADL) on the Adept website. For more details on the ADL, see Adept Document Library on page 15.

5.5 Installing Axis Labels

The system includes a set of axis directional labels that can be installed on the robot. See the following table. Also refer to Robot Axis Identification on page 9 for a drawing of the axis identification. The yellow X-Y label can be used to indicate the X and Y axes in the World coordinate system in your workcell.

Table 5-1. Axis Directional Labels

5.6 Caution Label on Robot

The Caution label shown in the following figure refers to rotation of Joint 4. When power is turned off, **do not** manually rotate Joint 4 more than the Joint Limits of $\pm 190^\circ$. If Joint 4 is rotated beyond these limits, the internal wiring can be damaged.



Figure 5-4. Caution Label on Joint 4 Rotation

NOTE: There is no CALSET operation on the Adept Viper robot, and there is no Installation and Maintenance Guide.

5.7 Installing User-Supplied Hardstops

For the purpose of limiting the robot working envelope, the hardstops, or mechanical ends, for Joints 1, 2, and 3 on the Adept Viper robots can be changed by installing user-supplied hardstops. In addition, the default softstops, or software limits, must be modified after the hardstops have been installed. For more information, see the [Adept Viper s650/s850 Hardstop Installation Guide](#).



CAUTION: Failures caused by user-supplied hardstops are not covered by the warranty, even if the robot is under warranty.

Chapter 6: Maintenance

6.1 Field-replaceable Parts



WARNING: Only qualified service personnel may service the robot system.

The only field-replaceable parts on the Viper s650/s850 robots are the encoder battery and the MB-60R/eMB-60R.

The Adept part number for the battery is 05234-000.

6.2 Periodic Maintenance Schedule

The following table gives a summary of the preventive maintenance procedures and guidelines on frequency.

Also, for cleanroom robots, see Cleanroom Option on page 93. For IP-54/65 robots, see IP-54/65 Option on page 89.

Item	Period	Reference
Check E-Stop, enable and key switches, and barrier interlocks	6 months	See Checking Safety Systems on page 71
Check robot mounting bolts	6 months	See Checking Robot Mounting Bolts on page 72
Replace encoder battery	2 to 7 years	See Replacing Encoder Backup Batteries on page 72

NOTE: The frequency of these procedures will depend on the particular system, its operating environment, and amount of usage. Use the times given here as guidelines and modify the schedule as needed.

6.3 Checking Safety Systems

These tests should be done every six months.

1. Test operation of:
 - E-Stop button on Front Panel
 - E-Stop button on pendant

- Enabling switch on pendant
- Auto/Manual switch on Front Panel

NOTE: Operating **any** of the above switches should disable high power.

2. Test operation of any external (user-supplied) E-Stop buttons.
3. Test operation of barrier interlocks, etc.

6.4 Checking Robot Mounting Bolts

Check the tightness of the base mounting bolts every 6 months. Tighten to 70 ± 14 N·m (52 ± 10 ft-lbf).

6.5 Replacing Encoder Backup Batteries



WARNING: The procedures and replacement of parts mentioned in this section should be performed only by skilled or instructed persons, as defined in the [Adept Robot Safety Guide](#). The access covers on the robot are not interlocked - turn off and disconnect power if covers have to be removed.



CAUTION: Replace the batteries only with 3.6 V, 8.5 Ah lithium batteries, Adept part number: 05234-000. Battery information is located in the base of the robot.

Battery Replacement Intervals

The encoder backup batteries should be replaced according to the intervals that follow.

- If the robot is kept in storage and not in production, or the robot is turned off (no 24 VDC supply) most of the time, then the batteries should be replaced every two years.
- If the robot is turned on with 24 VDC supplied to the robot half the time, the batteries should be replaced every four years.
- If the robot is turned on with 24 VDC more than half the time, then you can increase the replacement interval to seven years. If, for example, a robot is typically turned off only on weekends, the batteries would need to be replaced every seven years.

Battery Replacement Procedure

NOTE: Dispose of the batteries according to all local and national environmental regulations regarding electronic components.

Replace the batteries according to the following procedure:

1. Prepare a new set of three backup batteries for replacement.
2. Turn off AC power to the MB-60R/eMB-60R and DC power to the controller.
3. Remove the cover from the robot. See the following figure.

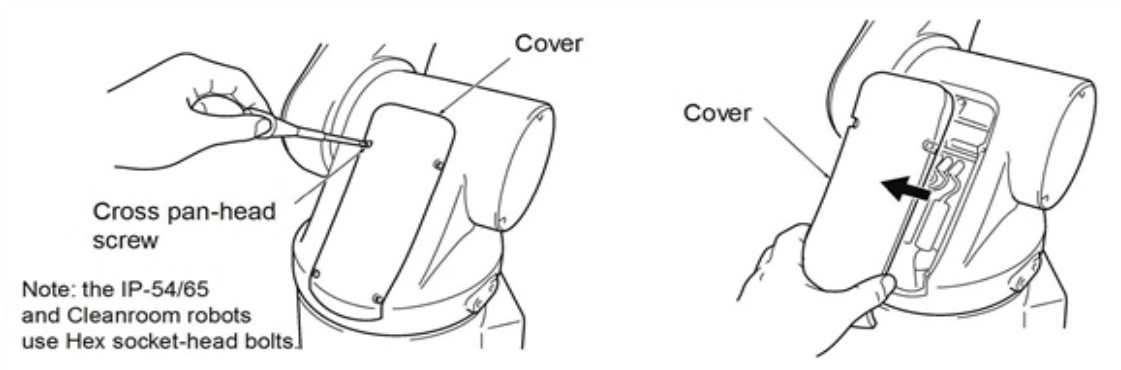


Figure 6-1. Removing Cover to Replace Encoder Batteries

4. Remove the dummy connector cap from the battery board. See the following figure.

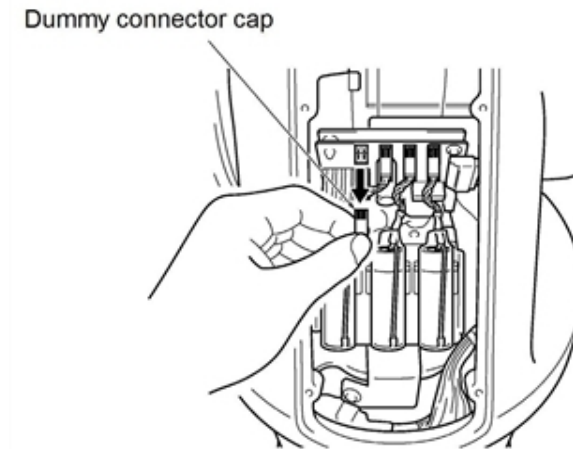


Figure 6-2. Removing Dummy Connector Cap

5. Connect a new battery (1st one) to the pin from which you disconnected the dummy connector cap in the previous step. See the following figure.

NOTE: Do not disconnect old backup batteries before connecting a new one to the pin from which the dummy connector cap is removed. If you do so, the encoder positional data may be lost.

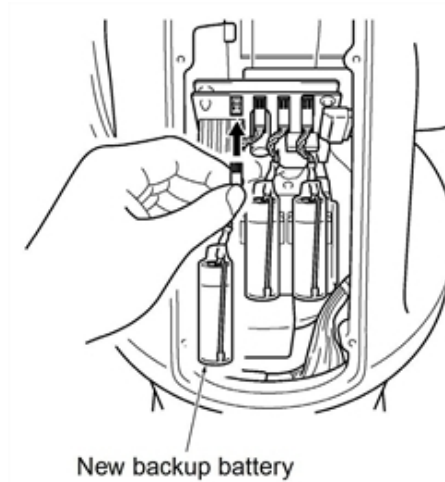


Figure 6-3. Connecting First New Battery

6. Disconnect the old backup battery that is next to the new battery connected in the previous step, and then connect a new battery (2nd one). See the following figure.

NOTE: Be sure to replace all of three batteries with new ones at one time. Otherwise, the battery service life will be reduced.

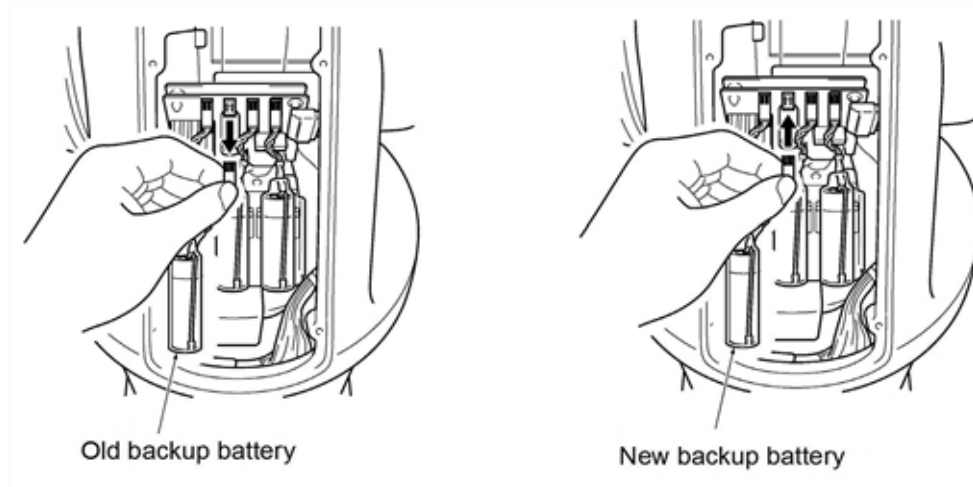


Figure 6-4. Connecting Second New Battery

7. Disconnect the old backup battery that is next to the new battery connected in the previous step, and then connect a new battery (3rd one). See the following figure.

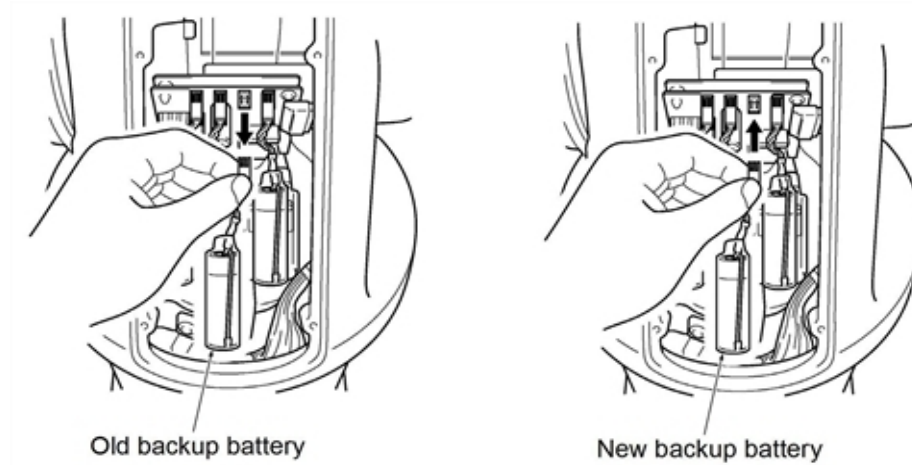


Figure 6-5. Connecting Third New Battery

8. Remove the last old battery and connect the dummy connector cap disconnected in Step 4. See the following figure.

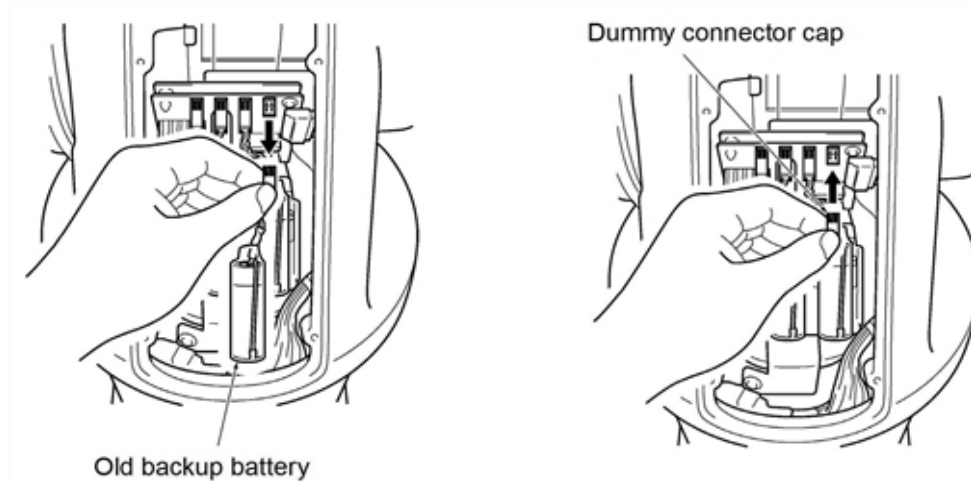


Figure 6-6. Reconnecting Dummy Connector Cap

9. Replace the cover on the robot.
 - Tightening torque: IP-54/65 models - Hex socket bolt: 2.0 N·m (1.5 ft-lbf)
 - Tightening torque: Standard models - cross pan-head screw: 0.59 N·m (0.4 ft-lbf)

6.6 Replacing the MB-60R/eMB-60R Amplifier

NOTE: An eMB-60R has two Ethernet connectors; an MB-60R has none.

Remove the MB-60R/eMB-60R Amplifier

1. Switch off the SmartController.
2. Switch off the 24 VDC and 200/240 VAC input supplies to the MB-60R/eMB-60R.
3. Disconnect the 24 VDC supply cable from the MB-60R/eMB-60R +24 VDC connector.
See Description of Connectors on MB-60R/eMB-60R Interface Panel on page 34 for locations of connectors.
4. Disconnect the 200/240 VAC supply cable from the MB-60R/eMB-60R AC connector.
5. Disconnect the XSYS cable from the MB-60R XSLV connector, or
disconnect the eAIB XSYS cable from the eMB-60R XSYSTEM connector.
If the system was upgraded from an MB-60R to an eMB-60R, you may need to disconnect the XSYS cable and eAIB XSLV Adapter from the XSYSTEM connector.
6. Disconnect the IEEE 1394 cable from the MB-60R/eMB-60R SmartServo connector.
7. Disconnect any other cables, which are connected to the MB-60R/eMB-60R, such as XIO.

Installing a New MB-60R/eMB-60R

1. Carefully remove the new MB-60R/eMB-60R from its packaging, check it for any signs of damage, and remove any foreign packing materials or debris.
2. Carefully place the MB-60R/eMB-60R next to the robot.
3. Connect the 200/240 VAC supply cable to the MB-60R/eMB-60R AC input connector.
4. Connect the XSYS cable to the MB-60R XSLV connector, or
connect the eAIB XSYS cable to the eMB-60R XSYSTEM connector.
If you are upgrading from an MB-60R to an eMB-60R, connect the existing XSYS cable to the eAIB XSLV Adapter, which connects to the eMB-60R XSYSTEM connector.
5. Connect the IEEE 1394 cable to the MB-60R/eMB-60R SmartServo connector.
6. Connect any other cables, which were connected to the MB-60R/eMB-60R, such as XIO.
7. Connect the 24 VDC supply cable to the MB-60R/eMB-60R +24 VDC input connector.
8. Switch on the 200/240 VAC input supply to the MB-60R/eMB-60R.
9. Switch on the 24 VDC input supply to the MB-60R/eMB-60R.
10. Switch on the SmartController.
11. Once the system has completed booting:
 - Verify that the new eMB-60R has been commissioned. The initial commissioning utility screen will tell you which functions are commissioned. See "Commissioning Status".
 - Test the system for proper operation.

6.7 Commissioning a System with an eMB-60R

Commissioning a system involves synchronizing the robot with the eMB-60R.

NOTE: This section only applies to robots that have an eMB-60R amplifier. A robot with an MB-60R amplifier does not need the Adept ACE commissioning.

For a new system with an eMB-60R, the robot and the eMB-60R will have been commissioned at the factory and should not need commissioning.

If you are replacing an MB-60R with an eMB-60R, you will need to commission the system.

In rare cases with a new robot with an eMB-60R, you may need to commission the system.

- If the system will not power up, and the robot status display shows SE, you need to commission the system.
- If the system will not power up in Manual mode, and the robot status display shows TR, you need to commission the system.

Safety Commissioning Utilities

The Adept eMB-60R adds two functions that implement safety in hardware:

- **E-Stop** serves as a backup to the standard software E-Stop process. The system will always try to stop the robot using the software E-Stop first. The hardware E-Stop will take over in the event of a failure of the software E-Stop.
- **Teach Restrict** limits the maximum speed of the robot when it is operated in Manual mode. As with the E-Stop, this is a hardware backup to software limits on robot speed. If the software fails to limit the robot speed during manual operation, the hardware Teach Restrict will disable power to the system.

These two functions are only in the eMB-60R amplifiers. They were not implemented in hardware in the MB-60R amplifiers, so these utilities do not apply to those amplifiers.

These two functions are supported by four wizards:

- **E-Stop Configuration**
This sets the E-Stop hardware delay to factory specifications.
- **E-Stop Verification**
This verifies that the hardware E-Stop is functioning correctly.
- **Teach Restrict Configuration**
This sets the hardware Teach Restrict maximum speed to factory specifications.
- **Teach Restrict Verification**
This verifies that the hardware Teach Restrict is functioning correctly.

Commissioning Status

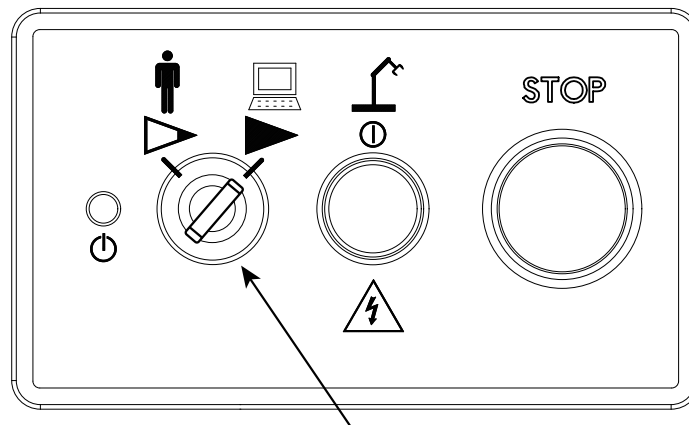
The initial utility screen will tell you which functions are commissioned. If a function is not commissioned, its verification wizard will not be displayed. Any displayed verification wizard can be run at any time, to ensure that its function is working properly.

Prerequisites

- The robot must be set up and functional.
- The robot must use eMB-60R amplifiers.

The MB-60R amplifiers do not support these hardware functions, and these wizards will not run.

- A PC with Adept ACE software version 3.3.2.10 or later must be connected to the eMB-60R.
- The Front Panel keyswitch must be in Auto mode.



Keyswitch in Auto mode

Figure 6-7. Adept Front Panel

- An Adept pendant is required for the Teach Restrict verification.
- No E-Stops can be activated.
- For Configuration (E-Stop and Teach Restrict), the eAIB Commissioning Jumper must be plugged into the XBELTIO jack on the eMB-60R.

NOTE: This is the only time that this jumper will be used. It is part number 11901-000, and must be removed for Verification and normal operation.



Figure 6-8. eAIB Commissioning Jumper

E-Stop Configuration Utility

This utility sets the E-Stop hardware delay to factory specifications.

NOTE: Ensure that the commissioning jumper is plugged into the XBELTIO jack on the eMB-60R before you start this procedure.

Procedure

From within the Adept ACE software:

1. Open the robot object editor.
Double-click on the robot object in the tree structure, usually the left pane.
2. Select **Configure > Safety Settings > Configure ESTOP Hardware Delay**, then click Next.
This procedure will configure Channel A and then Channel B.
It will then report the delay that it set for each.
3. If the SmartController does not reboot, cycle power on the SmartController.
4. Cycle power on the eMB-60R.

E-Stop Verification Utility

This utility verifies that the hardware E-Stop parameters are set correctly and that the hardware E-Stop is working.

The hardware E-Stop must have already been configured for this wizard to run.

NOTE: If the commissioning jumper is plugged into the XBELTIO jack on the eMB-60R, remove it before you start this procedure.

Procedure

From within the Adept ACE software:

1. Open the robot object editor.
Double-click on the robot object in the tree structure, usually the left pane.
2. Select **Configure > Safety Settings > Verify ESTOP Hardware Delay**, then click Next.
3. Enable high power, if not already enabled, then click Next.
4. Press an E-Stop button (on the Front Panel), then click Next.
The utility will confirm that the hardware delay has been verified for this robot, and display the delay times for channels A and B.
5. If the SmartController does not reboot, cycle power on the SmartController.

Teach Restrict Configuration Utility

This utility sets the hardware Teach Restrict maximum speed parameter to factory specifications.

NOTE: Ensure that the commissioning jumper is plugged into the XBELTIO jack on the eMB-60R before you start this procedure.

Procedure

NOTE: This procedure takes 2 or 3 minutes to complete.

From within the Adept ACE software:

1. Open the robot object editor.
Double-click on the robot object in the tree structure, usually the left pane.
2. Select **Configure > Safety Settings > Configure Teach Restrict**, then click Next.
3. From the Prerequisite screen, click Next.
The wizard will go through all of the robot's motors, and display messages that it is configuring Channel A and B for each.
It will then record the configuration, and display the target times that it set.
4. Click Finish.
5. If the SmartController does not reboot, cycle power on the SmartController.

Teach Restrict Verification Utility

This utility verifies that the Teach Restrict parameters are set correctly and that the hardware Teach Restrict maximum speed control is working.

This is a two-part wizard. The first is run in Auto mode. The second is run in Manual mode.

Before running this verification utility, the Teach Restrict must be configured.

NOTE: If the commissioning jumper is plugged into the XBELTIO jack on the eMB-60R, remove it before you start this procedure.

Automatic Mode Procedure



WARNING: The robot will move during this wizard.
Ensure that personnel stay clear of the robot work area.

From within the Adept ACE software:

1. Open the robot object editor.
Double-click on the robot object in the tree structure, usually the left pane.
2. Select **Configure > Safety Settings > Verify Teach Restrict**, then click Next.

3. Teach a Start Position.

NOTE: This procedure will move the robot approximately ± 5 degrees from the starting point of each joint.

This can be any position that does not conflict with obstacles or the limits of joint movements.

- If the robot is already in such a position, you can just click Next.
- Otherwise, move the robot to such a position, then click Next.
- The screen will display the number of degrees that each joint is expected to move during the verification process.
- You can click Preview Motions on this screen to view the motions at slow speed. The default speed is 10, but you can change that speed with this screen's speed control.
- You can click Move to Ready, to move the robot to the Ready position.

The robot will move each joint, in succession. It will generate an over-speed condition for each, and verify that the hardware detected the over-speed condition.

4. Click Next, to proceed to the Manual Mode Procedure.

If the Automatic Mode Procedure fails, you will not be allowed to proceed with the Manual Mode.

Manual Mode Procedure

The manual mode of this verification requires the use of an Adept pendant.

For this verification, the Front Panel keyswitch must be in Manual mode.

1. From the Introduction screen, click Next.
 - Set the pendant to Joint mode.
 - Set the pendant manual control speed to 100.
2. Click Next.
3. Using the pendant, jog any of the robot's joints until power is disabled.

This indicates that the Teach Restrict function is working.
4. Click Next.

The results of the verification will be displayed.
5. Click Finish.
6. If the SmartController does not reboot, cycle power on the SmartController.
7. Reset the Front Panel keyswitch to Auto mode.

Chapter 7: Technical Specifications

7.1 Robot Dimensions

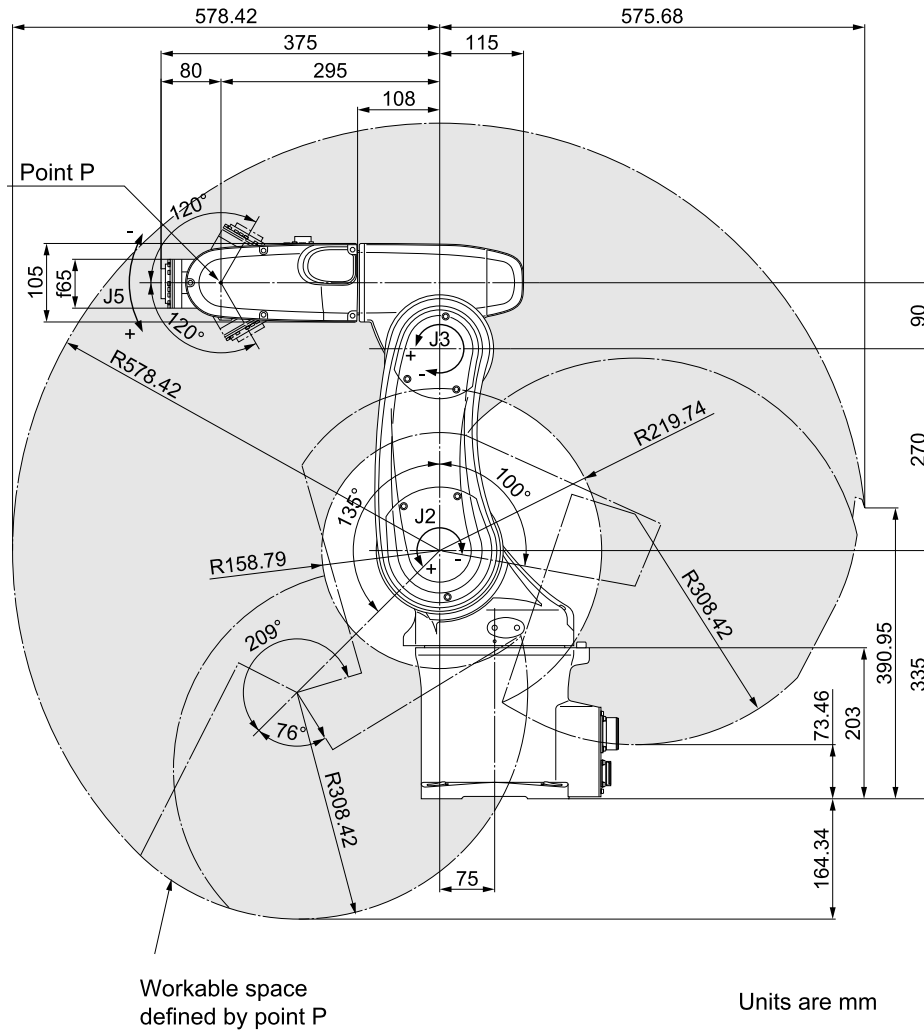


Figure 7-1. Adept Viper s650 Side Dimensions and Work Envelope

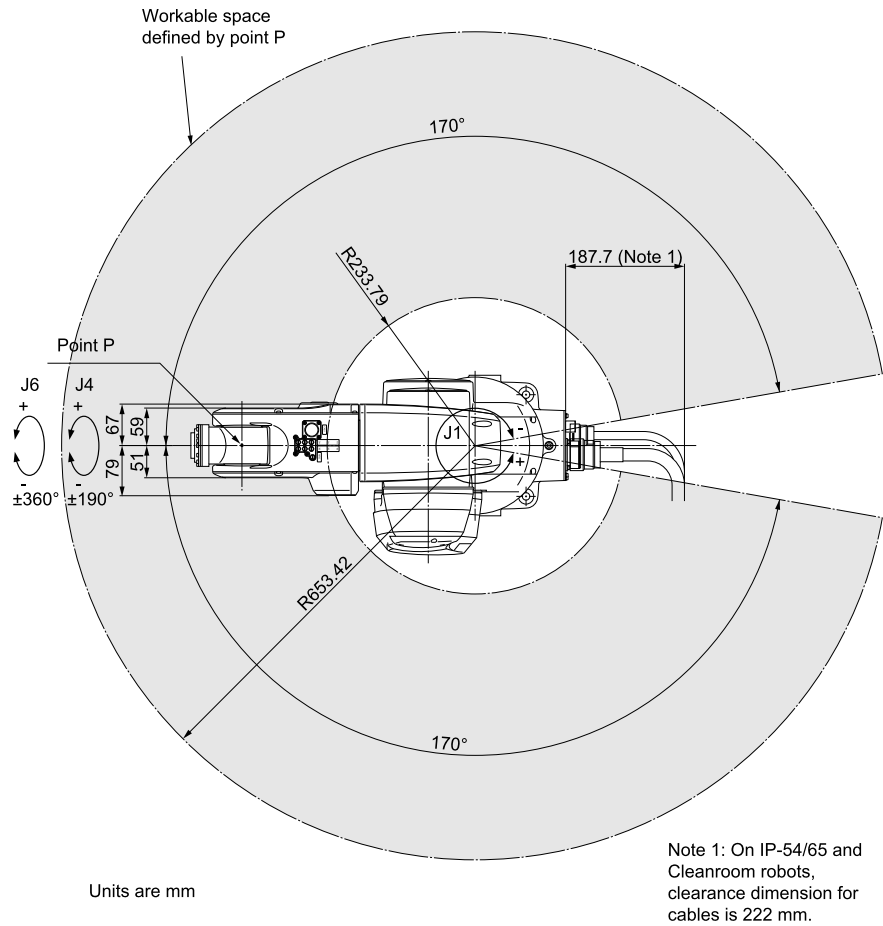


Figure 7-2. Adept Viper s650 Top Dimensions and Work Envelope

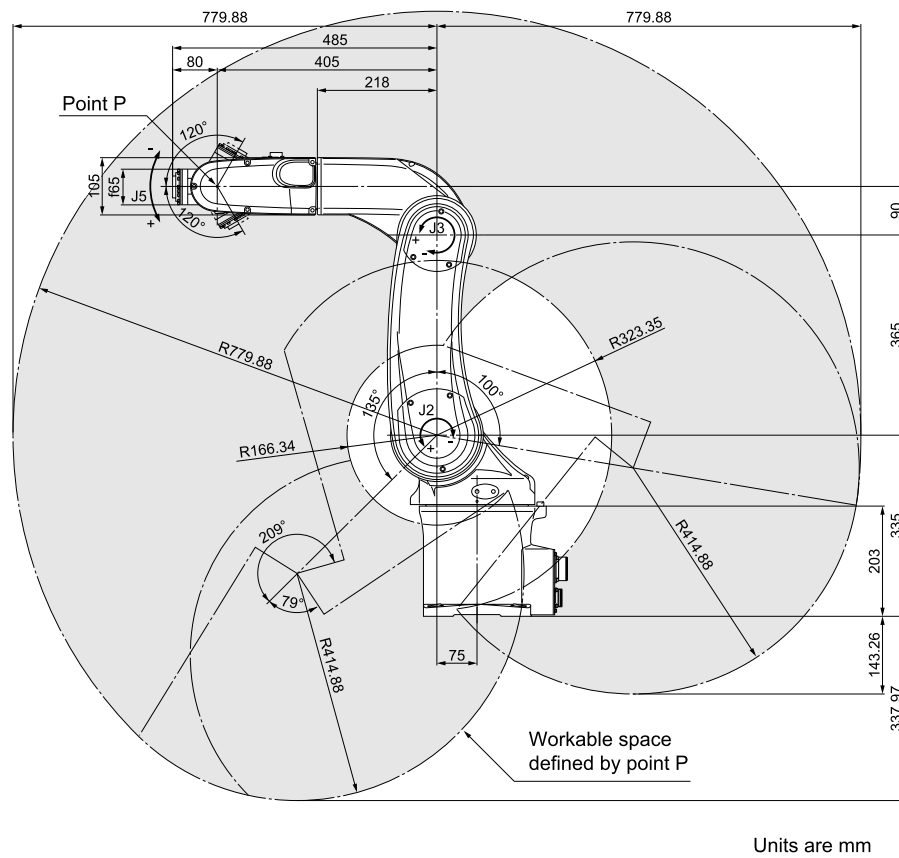


Figure 7-3. Adept Viper s850 Side Dimensions and Work Envelope

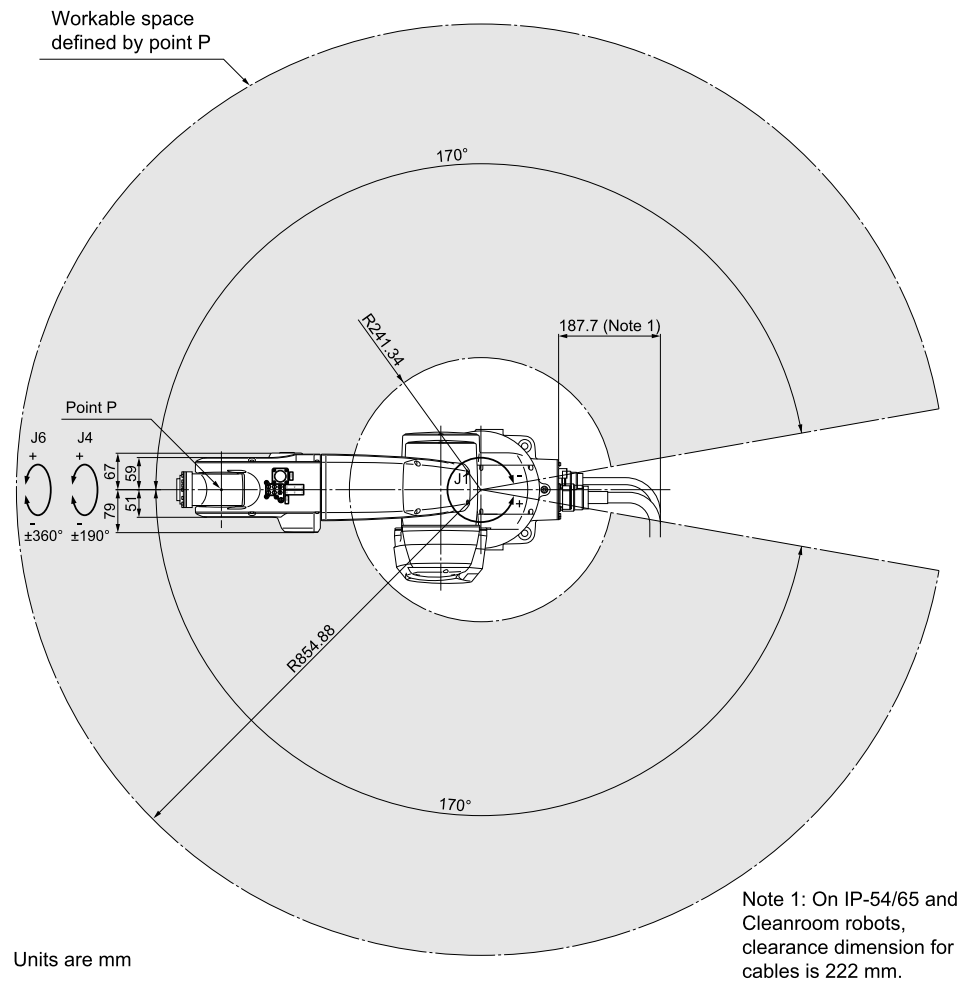


Figure 7-4. Adept Viper s850 Top Dimensions and Work Envelope

7.2 Robot Flange Dimensions

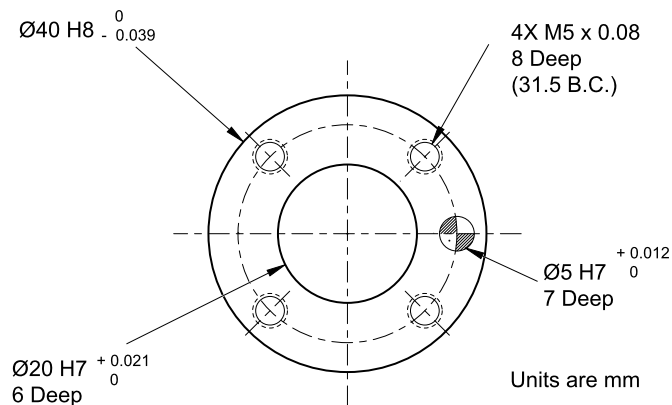


Figure 7-5. Robot Flange Dimensions

7.3 Specifications

Table 7-1. Robot Specifications

Specification	s650	s850
Overall arm length	270 (first link) + 295 (second link) = 565 mm	365 (first link) + 405 (second link) = 770 mm
Arm offset	J1 (swing): 75 mm, J3 (front link): 90 mm	
Maximum motion area	R = 733 mm (end-effector mounting face) R = 653 mm (Point P: J4, J5, J6 center)	R = 934 mm (end-effector mounting face) R = 854 mm (Point P: J4, J5, J6 center)
Motion range	J1: $\pm 170^\circ$ J2: $-190^\circ, +45^\circ$ J3: $-29^\circ, +256^\circ$ J4: $\pm 190^\circ$ J5: $\pm 120^\circ$ J6: $\pm 360^\circ$	
Maximum joint speed	J1: 328°/sec J2: 300°/sec J3: 375°/sec J4: 375°/sec J5: 375°/sec J6: 600°/sec	J1: 250°/sec J2: 250°/sec J3: 250°/sec J4: 375°/sec J5: 375°/sec J6: 600°/sec
Maximum composite speed (at the center of an end-effector mounting face)	8200 mm/s	7600 mm/s

Chapter 7: Technical Specifications

Specification	s650	s850
Maximum payload	5 kg	
Position repeatability (Note 1)	In each of X, Y and Z directions: ± 0.02 mm	In each of X, Y and Z directions: ± 0.03 mm
Maximum allowable inertia moment	Around J4: 0.295 kgm^2 Around J5: 0.295 kgm^2 Around J6: 0.045 kgm^2	
Position detection	Simplified absolute encoder	Simplified absolute encoder
Drive motor and brake	AC servomotors for all joints, Brakes for joints J2 to J6	
User air lines (Note 2)	7 systems ($\varnothing 4 \times 6$, $\varnothing 6 \times 1$), 3 solenoid valves (2-position, double solenoid) contained.	
User signal line	10 (for proximity sensor signals, etc.)	
Air source - Operating pressure	0.1 to 3.9 MPa (14.5 to 56.6 psi)	
Air source - Maximum allowable pressure	0.49 MPa (71.1 psi)	
Degree of Protection	IP-40 (IP-54/65 w/ option)	IP-40 (IP-54/65 w/ option)
Weight	Approx. 28 kg	Approx. 29 kg
Note 1 : Position repeatability is the value at constant ambient temperature.		
Note 2 : Only the $\varnothing 4 \times 6$ air tubing system may be controlled by built-in solenoid valves.		

Chapter 8: IP-54/65 Option

8.1 Introduction

The Adept Viper s650 and s850 robots can be ordered with an IP-54/65 option that is a dust-proof, splash-proof model. With the IP-54/65 option, the main body of the robot is rated IP-54, and Joints 4, 5, 6 are rated IP-65. Without this option, the robots have a rating of IP-40.



CAUTION: The SmartController and MB-60R/eMB-60R are not dust- or splash-proof. Therefore, when using these products in an environment exposed to dust or mist, put them in protective enclosures.



Figure 8-1. Adept Viper s650 Robot with IP-54/65 Option

8.2 Differences from the Standard Robot Model

The installation, operation, and specifications of the IP-54/65 robot are the same as the standard robot, except for issues noted in this section.

Installation Environment

The IP-54/65 robot should not be installed in any environment where:

- there are any flammable gases or liquids,
- there are any acidic, alkaline, or other corrosive gases,
- there are any large-sized inverters, high output/high frequency transmitters, large contactors, welders, or other sources of electrical noise,
- it may likely be submerged in fluid,
- there is sulfuric cutting or grinding oil mist.

NOTE: Any machining oil used around the robot must be compatible with NBR (nitrile) and a polyurethane resin paint.

Robot Connector Panel

For the IP-54/65 robot, the robot connector panel is different than the standard robot. The panel is shown in the following figure.

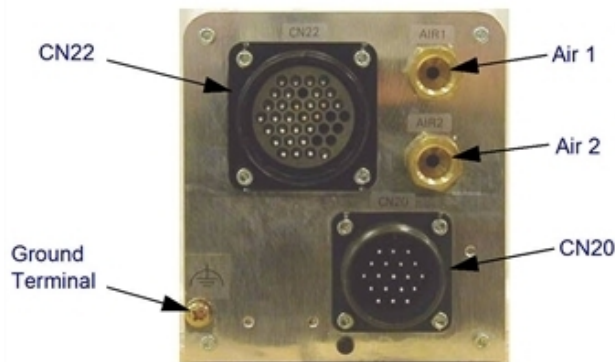


Figure 8-2. IP-54/65 Robot Connector Panel

NOTE: On the IP-54/65 robot, the CN20 and CN21 connectors are IP-65 rated. Also, the robot cable has a splash-proof connector on the robot end.

NOTE: The mating connector sets for CN20 and CN21 are different for IP-54/65 and Cleanroom robots. See Cleanroom Option on page 93.

NOTE: For IP-54/65 compliance, keep the factory-installed plugs over I/O connectors in place.

Cable Clearance

For the IP-54/65 robot, the cable clearance dimension at the back of the robot is 222 mm. See Technical Specifications on page 83 for dimension drawings.

Replacing Encoder Backup Battery

For the IP-54/65 robot, the procedure to replace the encoder battery is the same as the standard robot, except the cover uses hex socket-head bolts instead of screws. Removing Cover to Replace Encoder Batteries on page 73. Tightening torque: Hex socket bolt: 2.0 N·m (1.5 ft-lbf).

Chapter 9: Cleanroom Option

9.1 Introduction

The Adept Viper s650 and s850 robots are available in Class 10 Cleanroom models.

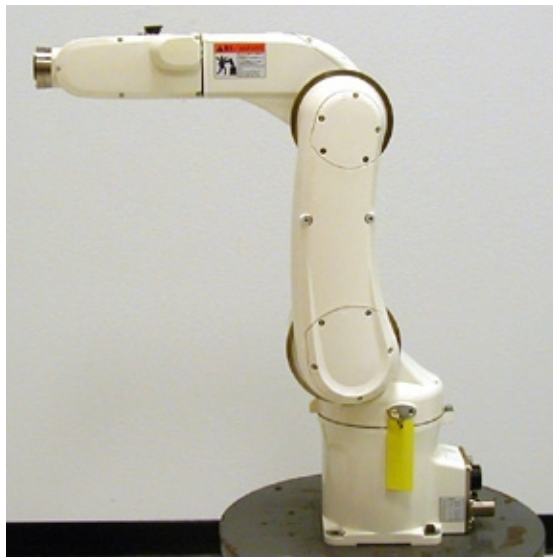


Figure 9-1. Adept Viper s850 Robot - Cleanroom Model

9.2 Differences from Standard Robot Model

The installation, operation, and specifications of the Cleanroom robot are the same as the standard robot, except for issues noted in this section.

Cleanroom Technical Specifications

Table 9-1. Cleanroom Robot Specifications

Adept Viper s650/s850	
Clean Class for Cleanroom Robot	Class 10
Recommended vacuum flow rate	130 liters/minute (4.6 SCFM)
User air lines	6 systems (Ø4x6), 3 solenoid valves (2-position, double solenoid) contained.

Robot Connector Panel

For the Cleanroom robot, the robot connector panel is different than the standard robot.

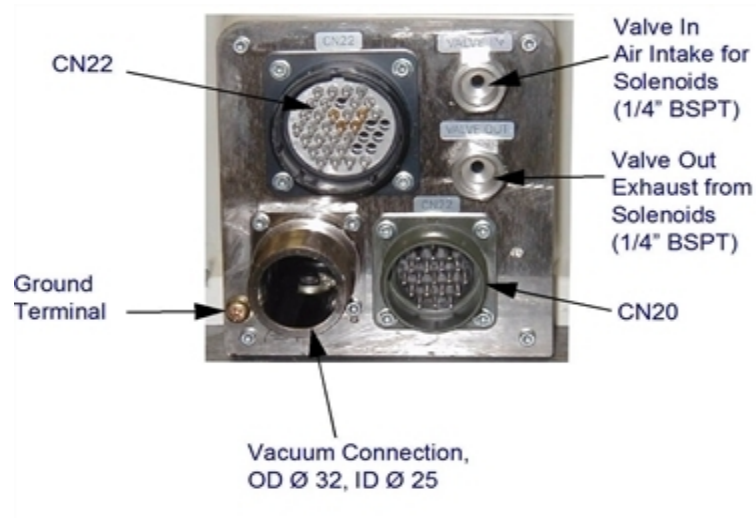


Figure 9-2. Cleanroom Robot Connector Panel

See Cleanroom Technical Specifications on page 93 for the recommended vacuum flow rate.

9.3 Air Lines and Signal Wiring

The Cleanroom robot is equipped with six air lines. The six lines, from Valve In input, are controlled by the three internal solenoid valves. There are ten user electric lines. The air lines and signal wiring are shown in the following figures and tables.

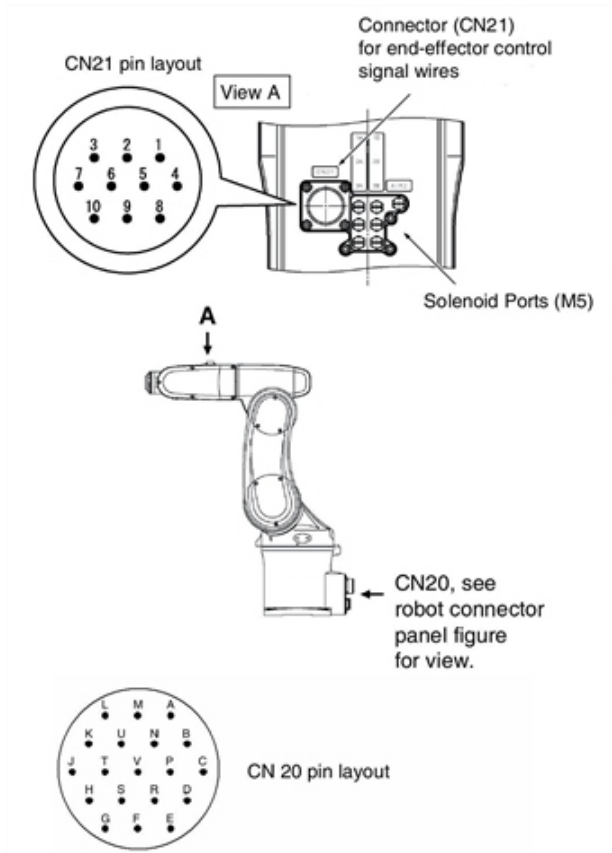


Table 9-2. Air Intake/Exhaust States

Air Connections		Valve Signal		
Intake (Valve in)	Exhaust (Valve out)	Sole- noid Valve	Solenoid	
			A	B
1A	1B	1	ON	OFF
1B	1A	1	OFF	ON
2A	2B	2	ON	OFF
2B	2A	2	OFF	ON
3A	3B	3	ON	OFF
3B	3A	3	OFF	ON
AIR 2 - Not used on Cleanroom robot				

Table 9-3. CN 20 Pin Assignments, M to U

NPN type (source IN, sink OUT)		PNP type (sink IN, source OUT)	
CN20 pin	Used for:	CN20 pin	Used for:
M	+24 V	M	0 V
N	Solenoid 1A (solenoid valve 1)	N	Solenoid 1A (solenoid valve 1)
P	Solenoid 1B (solenoid valve 1)	P	Solenoid 1B (solenoid valve 1)
R	Solenoid 2A (solenoid valve 2)	R	Solenoid 2A (solenoid valve 2)
S	Solenoid 2B (solenoid valve 2)	S	Solenoid 2B (solenoid valve 2)
T	Solenoid 3A (solenoid valve 3)	T	Solenoid 3A (solenoid valve 3)
U	Solenoid 3B (solenoid valve 3)	U	Solenoid 3B (solenoid valve 3)

Pins A to K on CN20 and #1 to #10 on CN21 are connected with each other as shown below. The allowable current per line is 1 A.

CN20	A	B	C	D	E	F	G	H	J	K
CN21	1	2	3	4	5	6	7	8	9	10

Use the supplied mating connector sets shown in the table below for CN20 and CN21.

CN20 and CN21 Mating Connectors

Table 9-4. CN20 and CN21 Mating Connectors

Connector Set Part No.	Connector No.	Model and Part Name	Appearance	Connector Set Part No.
05584-000	for CN20	H/M3106A22-14S (straight plug) (HIROSE ELECTRIC CO., LTD.)		
	for CN20	H/MS3057-12A (cord clamp) (HIROSE ELECTRIC CO., LTD.)	Applicable wire diameter 11.4 to 15.9	
	for CN20	H/MS3057-12A1 (cord clamp) (HIROSE ELECTRIC CO., LTD.)	Applicable wire diameter 8 to 11.6	
	for CN21	EBLP1610M (L type plug connector) (Dai-ichi Electronic Industry)		

NOTE: The mating connectors are the same for Cleanroom and IP-54/65 robots.

9.4 Cleanroom Cover at J6 Flange

The Cleanroom robot has a J6 Cleanroom Cover that is not present on the standard robot. See . Any user tooling at the flange must allow for clearance - see Figure 9-4.



Figure 9-3. Adept Viper s850 J6 Cleanroom Cover

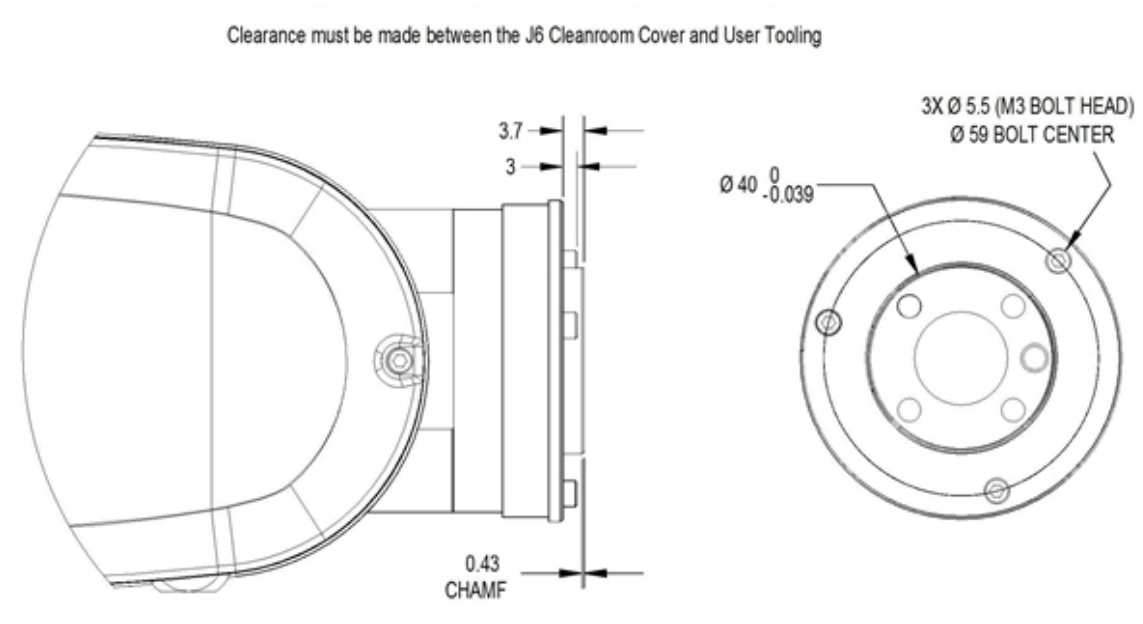


Figure 9-4. J6 Cleanroom Cover Dimensions

9.5 Cable Clearance

For the Cleanroom robot, the cable clearance dimension at the back of the robot is 222 mm. Technical Specifications on page 83 for dimension drawings.

9.6 Replacing Encoder Backup Battery

For the Cleanroom robot, the procedure to replace the encoder battery is the same as the standard robot, except the cover uses hex socket-head bolts instead of screws. See Figure 6-1. Tightening torque: Hex socket bolt: 2.0 N·m (1.5 ft-lbf).



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